SH&E International Air Transport Consultancy

SCAG REGIONAL AIRPORT DEMAND MODEL
MODEL DESIGN WORKING PAPER

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SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

Prepared by:

Cambridge Systematics, Inc.

Dr. Geoffrey D. Gosling

SH&E, Inc.

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Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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Aviation System Planning Consultant

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Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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1 INTRODUCTION

Southern California is served by seven primary commercial airports and represents, in aggregate, the nation's largest airline passenger market. Most of the region's commercial airports face physical, legal, or political constraints that limit their ability to accommodate future growth in passengers and/or aircraft operations. Overall airline passenger demand in Southern California is projected to increase substantially over the next 25 years and the region is facing major planning challenges concerning where and how this growth will be accommodated. The Southern California Association of Governments (SCAG) is developing the Regional Airport Demand Model in order to evaluate alternative airport development and utilization paths and to identify strategies that can effectively satisfy the transportation requirements of residents and visitors to the region.

Future patterns of airport utilization will be influenced by traffic conditions on the region's roadway network, while future roadway traffic congestion will be affected in part by growth in passenger demand at individual airports. In order to capture these effects, the Regional Airport Demand Model will be integrated with SCAG's existing Regional Transportation Model. Future ground access times from passenger ground origins to alternative airports will be passed from the SCAG ground transportation model to the Regional Airport Demand Model, and forecast passenger vehicle trips between airports and passenger ground origins and destinations will be passed back to the SCAG ground transportation model.

The same socio-economic variables and forecasts that SCAG uses in projecting future roadway traffic patterns will be used by the Regional Airport Demand Model to forecast the geographic pattern of future airline passenger trip generation in discrete ground zones across the Southern California region.

This report presents the proposed design of the Regional Airport Demand Model for the Southern California Region. The report presents the overall architecture of the planned model, together with the proposed design of each component of the model. It also discusses model implementation considerations, including the integration of the planned model with the other surface transportation modeling capabilities in use at SCAG, as well as the findings of a literature review that was undertaken as part of the project in order to identify the current state of practice of regional airport demand modeling and ensure that this was taken into consideration in the model design.

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Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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OBJECTIVES OF THE MODEL

The purpose of the model is to provide SCAG with an analysis capability to:

1. Project the future number and distribution of air passenger trip ends within the Southern California region,
2. Determine the allocation of these trips to airports serving the region and the associated levels of air service at each airport, and
3. Project the volume and composition of vehicle trips between each traffic analysis zone and airport in the region generated by future levels of air passenger traffic.

This analysis capability forms an essential component of the regional airport system planning process, and allows the airport system planning process to be integrated with the surface transportation system planning process in the region. This integration ensures that forecasts of the future distribution of air passenger traffic among airports serving the region fully reflect the projected future travel times on the regional highway system and available transportation alternatives (such as enhanced public transportation systems), and that the resulting vehicle and passenger flows are incorporated into the corresponding traffic projections for the different elements of the regional surface transportation system.

A key aspect of the planned model is to provide the capability to project future levels of air service at each airport serving the region, that are consistent with the projected choice of airport by air passengers traveling to and from the region. This capability forms an important input to the regional airport system planning process, since it affects the future facilities required at each airport as well as airport development plans. It also forms a key consideration in assessing both the need for new airports to serve the region, and the utility of particular locations for such airports. There is an inherent feedback loop between future levels of air service and the airport choice of air passengers. Airlines will only provide air service at an airport if they can do so economically, which implies that enough passengers have to choose to use that airport to make a given level of air service viable. Similarly, the number of air passengers who choose to use a particular airport will depend on the level of air service offered at that airport. A key objective of the planned model is to explicitly model this feedback effect, and thereby give SCAG transportation planners and the stakeholders involved in the airport system planning process an analytical capability to formally model this process.

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An important consideration in the design of the model is the policy context within which it will be used. As part of the regional airport system planning process, capacity limitations have been established for various airports in the region. These capacity limitations are subject to ongoing negotiation and policy-making at a local and regional level, and may be revised in the future. An important component of this decision making process is an understanding of how such capacity limitations can be implemented and whether any given distribution of air passenger traffic among the regional airports is economically or technically viable. In the last analysis, neither SCAG nor the individual airport authorities can direct passengers to particular airports or direct airlines to provide given levels of air service at particular airports. All that can be done is to change the pricing structure, available services, and operating rules within which the airlines make their service decisions and air passengers make their airport choice decisions. It is therefore necessary to be able to model how any given set of such policy decisions will affect the resulting traffic levels at each airport. The planned model has been designed to enable this analysis.

Since the modeling of both air passenger airport choice and surface access/egress mode choice require data from the regional surface transportation modeling process and generate traffic volumes that must be incorporated into that process, it is a requirement of the current model development that the resulting regional airport demand model can be seamlessly integrated into the other elements of the SCAG transportation modeling process. This includes both the modeling of future patterns of economic activity and land use within the region, as well as the modeling of the resulting traffic flows and levels of service on the surface transportation system, generally referred to as the urban transportation modeling system. A related consideration is the need to be able to account for the future development of new modes of intercity travel, such as the proposed high-speed rail system being developed by the California High Speed Rail Authority. Since the development of such a system is likely to impact the future volume and pattern of air travel, at least in those markets served by the new system, it is important that the regional airport demand model can reflect this effect in the projections of the future levels of air travel and their allocation to airports in the region.

A final consideration is the importance of an open and transparent model. The airport system serving the Southern California region is the largest multiple airport system serving a major metropolitan region in the world. This poses an enormous technical challenge to the airport system planning process. At the same time, the policy issues being faced are extremely complex and controversial, with a very large number of affected stakeholders, from the airport authorities involved, the airlines serving those airports, the affected communities, and a large number of other

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Aviation System Planning Consultant

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government agencies and interest groups. It is therefore imperative that those stakeholders can both understand how the modeling process produces the results that it does and can satisfy themselves that the assumptions used in the modeling process or implied by the model structure and coefficients are reasonable. This can only occur if the structure of the model is fully documented and the output allows users to see how the model generates the results that it does. This too is reflected in the planned model architecture.

CONSTRAINTS

The design of the model needs to address two different types of constraints in how it is used. The first is the need to be able to impose capacity limits on particular airports, as discussed above. While this can be handled by trial and error, adjusting the input assumptions until the desired capacity limit results, this is a very inefficient process and may not easily converge to a solution. Therefore it is desirable to provide an explicit capability within the model for users to impose a capacity limit at a particular airport and allow the model to adjust the input variables to satisfy this limit. The second type of constraint that the model system will need to address is user-specified forecasts of air travel demand at a regional level. While the proposed model design will generate its own regional forecast if this is desired, users may also wish to make use of an exogenously developed forecast. Therefore, the model design will provide the capability to specify the total regional air travel volume, either in total or by market segment, and adjust the allocation of the trip generation at a zonal level.

The design of the model must also consider the constraints imposed by the availability of data on the existing patterns of air travel and use of the current airport system. While in principle it is possible to develop a model at any desired level of disaggregation, such as air party characteristics, air travel markets, or geographical distribution of air party trip ends in the region, in practice the ability to estimate such models and the cost-effectiveness to do so depends on the availability of data on these characteristics at a suitable level of detail.

Model Constrained by Airport Capacity Limits

The implementation of a capacity constraint at an individual airport will require not only the capacity limit to be specified, but also the policy instrument that will be used to achieve this limit, such as increase in landing fee or a limit on the number of aircraft operations in specific markets. This prevents the model user from setting arbitrary and unachievable capacity limits. The model will then adjust the

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Aviation System Planning Consultant

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appropriate internal variables to ensure that the number of air parties allocated to that airport do not exceed the capacity limit. Of course, if the capacity limit is expressed in terms of aircraft operations rather than passengers, then the number of air parties allocated to the airport will be inherently limited by the capacity of the flights.

The mechanism by which this is achieved relies on the fundamental approach to yield management practiced by the airlines. Unless there is a dramatic change in the regulatory environment, it is quite unlikely that airlines will turn away passengers on full flights rather than raise fares. This does not necessarily mean that published fares will change, but the availability of cheaper fares will be restricted. Some passengers will still be able to get a cheaper fare, but the majority will either pay a higher fare or have to choose another airport. The effect of the reduced availability of cheaper fares will cause some passengers to choose another airport, thereby ensuring that the flights do not fill up and the capacity limits are achieved.

Modeling this process will require an iterative approach to a solution. If more than one airport has a capacity limit, then it may require a larger number of iterations to reach a solution. Developing an efficient approach to reaching a solution will be an important consideration in the model implementation.

Model Constrained by External Travel Forecasts

The ability to adjust the forecasts of future air travel by zone generated by the model to an exogenously provided forecast is simply a matter of proportionately adjusting the predicted number of trips in each zone, classified by market segment if the external forecast is given by market segment. However, it may be desirable to some users that the model output displays both the original and adjusted number of trips at a zonal level, so that the user can evaluate the extent of the change. In view of the large number of analysis zones, it may also be desirable to summarize this information in a more aggregate way, as well as providing the user with the ability to examine the underlying data at a zonal level. The effect on model development of the need to accommodate external forecasts will be a need for a highly-flexible, user-friendly, and transparent model application tool.

Model Constrained by Practical Data Issues

An important constraint on the ability to model air passenger travel demand and airport choice is the availability and consistency of data on existing patterns of air travel and air passenger behavior. While the airlines report detailed information on air passenger traffic levels in each market at an airport level, these data contain no information on air party characteristics, such as trip purpose, party size, income levels, or where the trip began or ended in the region. These data are typically only available from air passenger surveys.

A significant amount of air passenger survey data is available for the region. Los Angeles World Airports has recently completed a very detailed air passenger survey at Los Angeles International Airport (LAX) and Ontario International Airport (ONT), with some 21,000 responses at LAX and 6,200 at ONT. These surveys provide an excellent level of detail and sample size to model air travel demand and air party behavior at the two airports. The situation at the other airports in the region varies. For instance, air passenger survey information at Burbank Airport and John Wayne Orange County Airport is more limited. A survey of about 2,100 departing air passengers at Burbank in October 1999 identified the zip code of their ground origin, but apparently no other air party characteristics. An intercept survey of 600 air passengers at John Wayne Airport and a telephone survey of 500 Orange County households were conducted in July 2000. A survey of 1,200 air passengers at Palm Springs Regional Airport was undertaken in February 1998. The survey identified the zip code of residents of the region and the city where visitors to the region stayed during their visit but did not ask if either location was where they began their trip to the airport. A survey of 950 households in the Palmdale area was undertaken in May 1998 and asked questions about the respondents' air travel during the previous year and the use of different airports in the region. There is also an ongoing customer service survey at Long Beach Municipal Airport that began in September 2002. In addition, some air passenger survey data are available for San Diego International Airport and Santa Barbara Municipal Airport. These airports are outside the SCAG region, but they draw some passengers from zones near the edge of the region.

A modeling design and implementation challenge will be to integrate these survey data as effectively and efficiently as possible. The air passenger surveys were conducted for different reasons and at slightly different points in time, using different survey questions, and different sampling strategies and sample sizes. The proposed model design reflects the need for this data integration, as well as the possibility of taking advantage of future survey data if and when they are collected.

ORGANIZATION OF THIS REPORT

The remainder of this report consists of seven chapters. Chapter 2 briefly summarizes the findings of a literature review that was undertaken as part of the project with the goal of identifying the current state of practice in the development of regional airport demand models. Chapter 3 addresses model objectives and implementation considerations. Chapter 4 presents an overview of the proposed model architecture.

The following three chapters describe the three basic components of the model. Chapter 5 describes the air passenger demand component, that predicts the number of air party trips generated in each analysis zone and the distribution of these trips among the various air service markets. Chapter 6 describes the airport choice and access mode choice component of the model that allocates the predicted air party trips with a trip end in each zone to specific airports in the region and estimates the percentage of the air party trips between each zone and each airport that use the various surface transportation modes. Chapter 7 describes the air service component of the model that predicts how the air service in each market at each airport in the region is expected to evolve.

Finally, Chapter 8 discusses the proposed next steps in the implementation of the regional airport demand model.

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Aviation System Planning Consultant

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2 CURRENT PRACTICES IN AIRPORT MODELING

As part of the first phase of the project an extensive literature review was undertaken to identify the current state of practice in the development of regional airport demand models and examine the implications for the design of the model. This chapter summarizes the findings of the review. A more detailed discussion of the findings and a summary of the relevant literature identified in the course of the review are contained in a separate report by the project team titled *SCAG Regional Airport Demand Model – Literature Review*.

The review identified a fairly large number of studies that have attempted to model air passenger airport choice or the ground access mode choice of air passengers traveling to airports. In contrast to airport choice and airport ground access mode choice, very little work appears to have been done to model air passenger trip generation at the zonal level, or to forecast how air service can be expected to evolve in a multiple airport region. Since both aspects are important to the process of modeling the future allocation of air passenger demand in a multiple airport region, these are aspects that will require careful attention in the development of the regional airport demand model.

AIRPORT CHOICE AND AIRPORT GROUND ACCESS MODE CHOICE

Several studies have been conducted that have modeled air passengers' airport choices in multi-airport regions and their airport ground access mode choices. It is worth noting that none of these models considered the ground egress mode choice of air travelers leaving airports and whether this choice process differs from the access mode choice. This undoubtedly results from the fact that most air passenger surveys are performed in airport boarding lounges and tend to focus on how the respondents traveled to the airport, not how they plan to leave the airport when they return (in the case of those beginning their air trip) or how they left the airport when they arrived (in the case of those beginning the return part of their air trip). However, since the directional patterns vary by time of day and it is usually far more critical how long the access trip takes, since a delay could result in a missed flight, there is good reason to expect that the mode choice decision process may be different in the two directions. Since the LAWA Passenger Surveys did ask questions about the passengers' ground egress mode choice, this issue will be further examined during model development.

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Aviation System Planning Consultant

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In spite of the importance of airport choice and airport ground access mode choice in the airport planning process, past attempts to model these choice processes do not yet appear to have developed a clear consensus on detailed functional forms for the models or variables to be included. However, best-practice general approaches can be identified.

The literature indicates that there is growing agreement that the nested logit model appears to have the most appropriate structure for analyzing airport choice and ground access mode choice. Travelers should be classified into categories by both trip purpose and residency (resident or non-resident status) for best use of this model form. Other non-traditional classifications, such as by length of haul, should also be studied, because of their potential for explaining some of the variations in mode choice that cannot be explained by traditional variables. For airport choice, variables accounting for air fare, flight frequency, and overall ground access service have been effective. For ground access mode choice, variables accounting for travel time, travel cost, and income have been shown to be important. Other variables, such as the amount of luggage and the gender of the traveler have also been shown to influence the use of public transportation modes.

However, partly as a result of differences in functional form and partly as a result of differences in the datasets used to calibrate the models, there is very little consistency in the parameter values estimated across the different models. Thus it is unclear whether there is an underlying behavioral pattern that is consistent across different communities and situations.

For both types of models, there will be a need to experiment with several alternative variables and functional forms in the utility functions and to attempt to resolve the inconsistent results presented in the literature. New variables that have not been used widely in the models to date would be especially useful if they address aspects of the choice process that are likely to be influenced by different ground access policy alternatives, such as travel time reliability, walking distance involved in connections between public transportation modes, or the ability to check baggage at off-airport locations. However, the lack of studies addressing situations where significant numbers of travelers face alternatives involving these issues, or the lack of the relevant data in air passenger surveys or regional transportation system datasets, has limited the ability to address these issues.

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AIR PASSENGER TRIP GENERATION

In spite of the very limited literature on air passenger trip generation, it is clear that the type of trip origin or destination is an important determinant of the distribution of air party trip ends in a region, and hence the number of air passenger trips that are generated by a given zone. The type of trip end can be divided broadly into residences, businesses and hotels. The proportion of trips that begin or end at each type of location not only depends on the purpose of the trip, but also on the time of day of the trip. Residents of the region departing on a business trip may begin their trip to the airport from their home if their flight is in the morning, but from their workplace if their flight is in the afternoon or evening. Similarly, visitors to the region who are not visiting family or friends will typically begin or end their trip at a hotel. However, the geographical distribution of these trips is likely to vary depending on whether the purpose of the trip is business or leisure.

Therefore an analysis of trip generation rates needs to consider the different trip purposes, including whether visitor trips involve visiting family or friends or staying in a hotel (recognizing that some visitors stay in a hotel, even though they are visiting family or friends). The location of tourist attractions may also be a significant factor in where visitors to the region who are not visiting family or friends choose to stay. This is a particularly important issue in Southern California, with its world famous tourist attractions, such as Disneyland and Hollywood. Likewise, the distribution of different types of business activities across the region is likely to influence where visitors on business trips choose to stay.

The effect of household income on the propensity to make air trips is also a significant factor that needs to be taken into account in analyzing trip generation rates. Since air travel propensity varies non-linearly with household income (very poor people can afford to make very few air trips and there is a limit to how many air trips even very wealthy people can make), the distribution of household incomes within a zone may be more important than the average household income in analyzing trip generation rates. Similarly household composition may also be a significant factor, since households with a large number of children will make fewer air trips than those with no or few children for a given level of household income.

Finally, there is the question of whether proximity to an airport increases air trip generation rates. There appears to be some empirical evidence in the literature to support this hypothesis. It is also not unreasonable that people who make a large number of air trips choose to live within a reasonable distance of an airport. However, it is also possible that this apparent effect is a result of other factors that happen to be correlated with proximity to existing airports (in fact the airports may

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Aviation System Planning Consultant

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have developed where they did because of their proximity to these other factors). This is not simply an academic debate over cause and effect but becomes an important issue if air service is expanded at secondary airports or new airports are developed, since if trip generation rates include an effect for proximity to airports (presumably weighted in some way by the level of air service at each airport) then increasing air service at a secondary airport or developing a new airport will not only divert trips from other airports but will actually generate more trips in total. This is sometimes referred to as induced demand.

AIR SERVICE FORECASTS

While there are relatively few models that have examined how air service evolves at different airports in a multiple airport region, there are a large number of studies that have examined different aspects of this process, such as the effect of fare and frequency differences on airline market share. The two studies that have attempted to model how air service evolves in a multiple airport region have found that the distribution of trip ends within the region tends to result in a stable equilibrium, and a model that considers both the ground access time and the flight frequency iterates to a solution that is fairly close to the pattern of service that is actually observed. While these studies may have benefited from the nature of the airport market under study and the simplified air service forecasting hypotheses that they used, their findings are quite encouraging for our effort because they indicate that a common modeling framework may be used to consistently measure air passenger demand and air service provision at multiple airports. Being able to model the airport supply-demand interaction will be a critical issue if growth of the largest airport in a region (such as Los Angeles International Airport) is constrained and therefore more airlines attempt to provide service at secondary airports.

Clearly having three flights a day in a given market by each of three different airlines is not the same thing as having nine flights by a single airline in terms of the frequency of service compared to that at the primary airport in the region. However, it would significantly complicate the air service forecasting model to attempt to predict airline market share at each airport. A related issue is the introduction or expansion of air service to an airport that is a connecting hub for an airline. The effect of this service is very different if it is provided by the airline operating the hub compared to some other airline, since it provides opportunities for the traveler to connect to a much larger set of destinations.

While the literature provides little guidance on how to resolve the thorny issues of how to fully address airline competition and differential airline air service cost

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Aviation System Planning Consultant

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structures in the air service forecasting model, it does indicate that they should be considered. Therefore, our proposed modeling approach includes the evaluation of different techniques for forecasting air service at the different airports.

In designing the service forecasting component, we will consider the inclusion of variables such as the number of carriers serving the market, whether the air destination is a carrier hub, and potentially other measures. Decisions regarding their inclusion in the module will be based on (1) the extent to which their presence increases the explanatory capability of the model in predicting the observed base year airport choice patterns; and (2) an assessment regarding the reliability with which the specific variable could be forecast.

If a particular measure such as the number of carriers providing nonstop service from an airport makes a strong contribution to the explanatory capability of the airport choice module, but is judged impractical to forecast., it may be possible to include the variable in the forecasting algorithm, assigning an observed value in the base year period, and a neutral or undefined value (that might later be supplied) in future forecasting years. This would permit analysis that are closely tied to current or recent conditions to benefit from its inclusion, while preventing predictive distortions in future years.

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3 MODEL OBJECTIVES AND APPLICATION ISSUES

MODEL REQUIREMENTS

In designing the Regional Airport Demand Model, SCAG and the project study team have attempted to consider the range of potential model applications that may be required by SCAG staff and other users in the future. Issues that the model is intended to address would include those such as the following:

- The impacts of current or future constraints at individual airports on the efficiency of the region's air transportation system;
- How future growth in airline passenger demand and changes in airport utilization will affect traffic conditions on the region's roadway network;
- The ability of individual airports in the region to support airline services to new destinations;
- The viability of potential new commercial airport sites based on their ability to attract passengers and support a critical mass of scheduled airline services, and the degree of relief that could be provided to the existing commercial airports;
- The extent to which future high speed rail services would divert passengers from airline services and the impacts on specific airports in the region;
- How improved ground access to specific airports would affect overall patterns of airport utilization within the region; and
- The impact of potential demand management strategies at individual airports on patterns of airport utilization and ground access efficiency.

In order to permit these types of analysis, the Regional Airport Demand Model must have a number of specific capabilities, including:

- The capability to accept and incorporate capacity constraints, whether these are based on the physical limitations of individual airports or driven by legal or political factors;
- The ability to accept externally produced forecasts of regional aviation demand, in addition to the capability of developing internal forecasts;

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Aviation System Planning Consultant

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- The ability to add and evaluate new potential airport sites in the regional airport system;
- The ability to generate internal projections of airline service patterns at existing and new airports in the system;
- The capability of accepting user input assumptions regarding future airline service patterns;
- The ability to test the viability of assumed or internally projected service patterns and adjust these services as necessary to bring service into balance with passenger demand; and
- The ability to quantify and report measures such as total airport passengers, aircraft operations, average ground access times, vehicle miles traveled by passengers to access airports, and other measures useful in evaluating the performance of individual airports and the regional airport system.

MODEL DESIGN ISSUES

In addition to providing the specific technical capabilities listed above, the model system design reflects the general issues described below.

Integration with SCAG Models

The regional airport demand model needs both to access highway travel time and socioeconomic data from the SCAG surface transportation models and land use models and to provide data on resulting air passenger vehicle trips and airport activity levels for incorporation in those models. Because of the iterative nature of both the regional airport demand model and the other SCAG models, it is assumed that this integration will occur through access to common data tables by the separate models, and the models may or may not be run synchronously.

Future Values of Input Variables

The use of the regional airport demand model to predict future patterns of air travel and airport use will require assumptions about future values of the input variables. While forecast values for some of these variables can be obtained from other SCAG modeling activities, such as population, economic activity and land use models, or the surface transportation system models, future values of other variables will have to be estimated exogenously.

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A particularly difficult issue arises with respect to predicting future levels of air fare at different airports in the region. What matters from the standpoint of airport choice is not the average fare in a given market at a particular airport, but the fares available to each air party at the time they make their travel decision. As this is influenced by airline yield management practices as well as travel trip purpose and timing, it will be necessary to approximate this process in the model at a simplified level.

Future values of other variables, such as income distributions or costs of different transportation services, will generally not be available from existing sources and will have to be estimated. Some guidance may be necessary for users of the model on how to do this, and the implications of making different assumptions.

Incorporation of Uncertainty

The future is inherently uncertain. Factors will change in ways that are not expected. While models of past air passenger behavior can be estimated from data on observed air passenger behavior, this behavior may change in the future. The model needs to be able to be adapted to account for such changes, if there is reason to believe that they might occur. This will require the capability for users to modify the model parameters. However, great care is needed in doing this, to avoid selecting values that produce implausible results. Therefore some guidance will be needed for users of the model on how to do this, and what are reasonable changes to make.

Even if air passenger behavior does not change, the difficulty of predicting future air service decisions and the inherent uncertainty in predicting future values of economic variables and other factors means that no forecast is likely to turn out completely correct. Therefore users of the model may want to know the range of likely outcomes, rather than the "best guess" at a single outcome. This can be accomplished through the analysis of multiple scenarios, in which the values of the input variables are varied over a reasonable range. However, some combinations of input variable values are implausible, or even impossible. Therefore, as with changes to the model parameters, this may require some guidance for users for users of the model, as well as some limitations within the user interface to prevent the users making unreasonable changes.

Ability to Address New Issues or Enhance Model Capabilities

It is expected that the regional airport demand model will be in use for the foreseeable future. As time goes on, new issues will emerge that will need to be addressed and further studies and additional survey data may result in a better understanding of the underlying behavioral and decision processes. It is desirable

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Aviation System Planning Consultant

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that the model can continue to evolve to be able to address these issues and incorporate this better understanding of the processes in question.

Therefore, the proposed model design relies on a modular architecture that will facilitate the enhancement of any particular component of the model or even the addition of a new component to address an entirely new issue.

Model Complexity and Computational Considerations

The nature of the problem being addressed by the regional airport demand model is inherently complex, involving decisions by a wide range of air travelers considering many different aspects of their trip, as well as different types of decisions by multiple airlines in a highly competitive environment. Therefore it is inevitable that any realistic model will be necessarily complex. The challenge in developing a workable model is to keep this complexity as manageable as possible. This will require a simplified representation of some elements of the system, such as the airline yield management process and the air traveler choice process. The extent to which the representation of these processes can be simplified without losing the desired accuracy of the results will be explored in more detail in the next phase of the project.

A key determinant of model run times is the number of air parties that the model has to assign to an airport. The approach followed in the type of model proposed is to generate a sample of air parties representing some period of interest, such as an average day. This sample is distributed across the analysis zones in the region and is assigned air party characteristics, such as air travel destination, travel party size and so forth that is broadly representative of the total market for air travel in the region. The model then computes the probability of each of these parties choosing each of the regional airports, as well as the associated surface access mode. These probabilities are then used to compute the air passenger traffic volume at each airport as well as the vehicle trips between each zone and each airport. The model run times can be reduced by generating a smaller sample of trips (or only assigning a smaller sample of trips) and then factoring the resulting traffic levels up by an appropriate amount, at the cost of some loss of resolution of the model outputs at the zonal level. This provides a way for the user to balance run times against model resolution. It may also be used during model iteration to reduce run times. Initial iterations can be performed using a smaller sample of trips, then the sample size increased during the last few iterations to improve model resolution.

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4 OVERVIEW OF PROPOSED MODEL ARCHITECTURE

This section provides a brief description of how the proposed model system will be designed and how the model components will correspond to each other.

PROPOSED MODEL STRUCTURE

Figure 4.1 shows the overall model structure for the proposed model system. The model system will consist of three main modeling components that will be linked through feedback loops:

- The air passenger demand component determines the overall passenger demand for intercity travel;
- The airport allocation and access component predicts how the overall intercity passenger demand will be distributed among the Southern California airports and among the airport access modes;
- The air service supply component predicts how the airlines will change their service levels in response to the predicted demand and air system constraints;
- If the output of the air service supply component (predicted service levels given demand levels) is consistent with the supply levels that were estimated in applying the other model components (predicted demand levels given supply levels), then the model system reports its forecasts.
- If there is a mismatch between the model components, then the model components are re-run until equilibrium is achieved and forecasts are reported.

Within each of the model system components, there will be one or more modules that will be designed to provide specific interim model results and to provide inputs for other modules. The model system's modular approach will facilitate subsequent model improvements as newly available and newly collected data allow for model updates. In addition, the modular approach will provide users with the flexibility to introduce independent exogenous forecasts of air passenger demand and air services into the model system.

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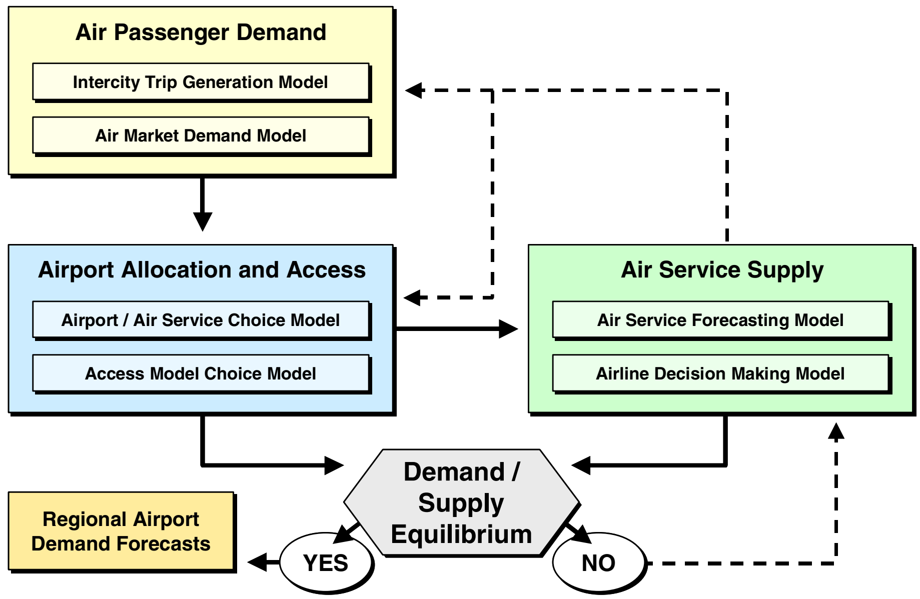
The following sections outline the model components and the specific airport model modules.

Figure 4.1: Model Structure



AIR PASSENGER DEMAND MODEL COMPONENT

The air passenger demand model component will generate forecasts of analysis zone intercity travel activity and apply predicted intercity travel service levels to translate these zonal trip end forecasts into forecasts of intercity trips from the zones to specific intercity travel markets. The model component has two modules:

- The intercity trip generation model predicts the number of intercity trips that will be generated in each analysis zone; and
- The intercity market demand model predicts the origin-destination intercity market distribution of the generated trips.

Figures 4.2 and 4.3 show the inputs and outputs of these modules. As shown in Figure 4.2, the intercity trip generation model will be developed by defining the base year relationship between intercity travel to/from each zone and the characteristics of the zone and the generalized cost of making intercity trips from that zone. Separate relationships will be developed for several travel market segments. In model application, these relationships are extended into the future to translate forecasts of zone characteristics and intercity levels-of-service into intercity trip generation forecasts.

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Figure 4.2: Intercity Trip Generation Model, *Model Inputs and Outputs*

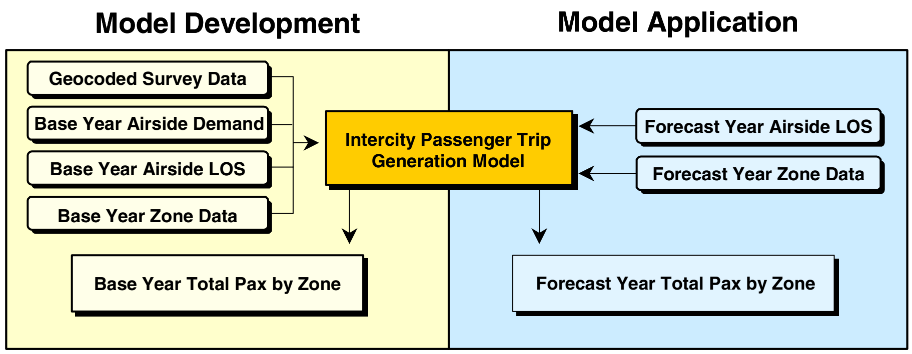
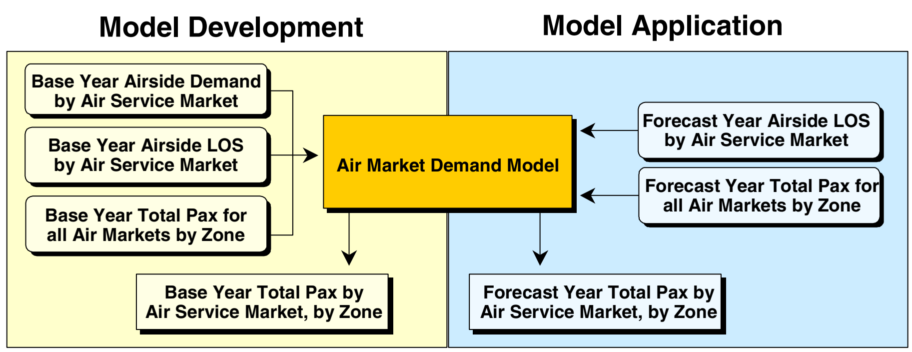


Figure 4.3: Air Market Demand Model, *Model Inputs and Outputs*



As Figure 4.3 shows, the intercity market demand model will use base year and historical information on the service levels and demand for specific intercity travel markets to forecast future demand for those markets.

The output of the air passenger demand model component will be market segment specific forecasts of intercity travel from each analysis zone to each intercity travel market.

AIRPORT ALLOCATION AND ACCESS MODEL COMPONENT

The airport allocation and access model component will take the outputs of the intercity passenger demand model component and allocate those passengers to air service types, airports, and airport access modes.

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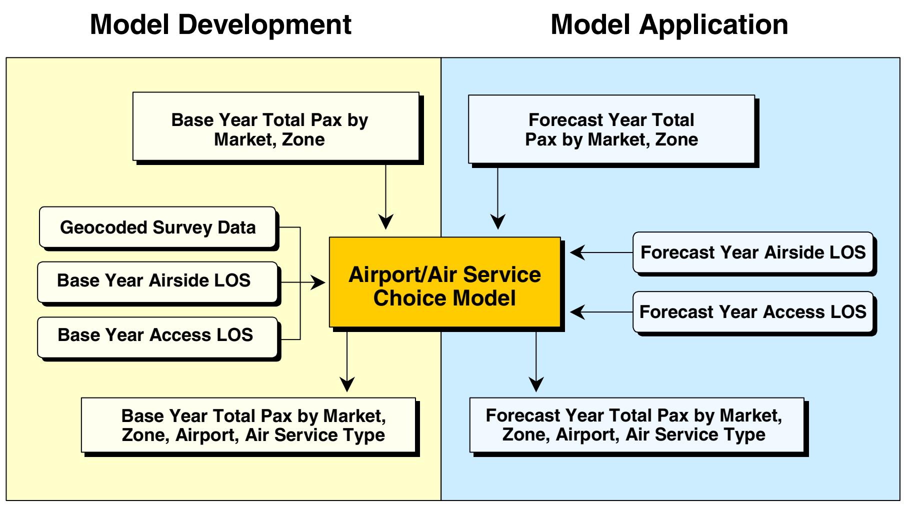
Figure 4.4 shows the model inputs and outputs for the first module of this model component, the airport / air service type choice model. The airport / air service choice model will predict how the air trips generated for a particular forecast year will be distributed among airports and among air service types at those airports. Air service types will be defined by a combination of airplane type, airline type, service connectivity, and fare availability/restrictions. The model will treat airport choice and air service choice as a joint decision since the two aspects of travel are so intertwined.

Figure 4.4: Airport / Air Service Choice Model, *Model Inputs and Outputs*



The second module of this model component will be the airport access mode choice model. The inputs and outputs of this module are summarized in Figure 4.5. The airport access mode choice model distributes the air passenger trips between each analysis zone and each specific airport among the various access mode options.

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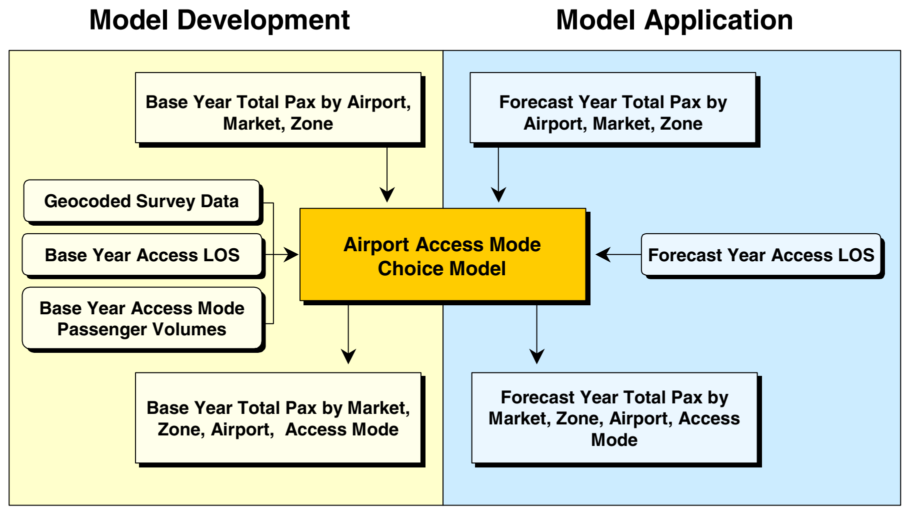
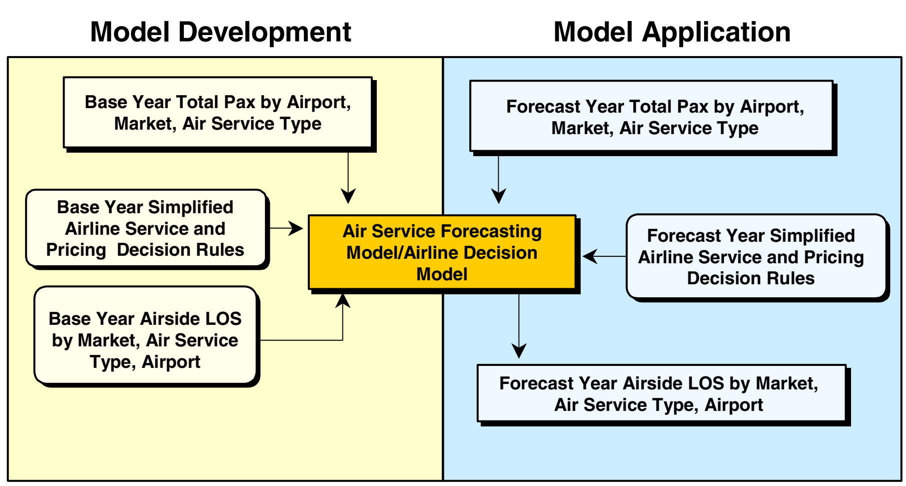
Figure 4.5: Airport Access Mode Choice, *Model Inputs and Outputs*



AIR SERVICE SUPPLY MODEL COMPONENT

The air service supply model component predicts the amount and types of airline service that will be offered at each airport to serve the demand predicted by the other model components. The inputs and outputs to this model component are shown in Figure 4.6.

Figure 4.6: Airport Forecasting Model, *Model Inputs and Outputs*



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The model component will predict forecast year air service frequency, fare levels, and types of airline services by intercity market and Southern California airport based on the predicted market demand and on simplified airline service and pricing decision rules that will be defined based on historical airline activity.

INTEGRATION WITH THE SCAG REGIONAL TRAVEL DEMAND MODEL

A key anticipated use of the regional airport demand model will be to provide air passenger airport access/egress vehicular traffic forecasts to SCAG's regional travel demand model. The coordination of the models will allow SCAG to include scenario specific airport trips in regional highway and transit assignments.

Because the airport model will need to integrate with current and future regional modeling software, we will need to develop the airport demand modeling tool as a generic stand-alone platform that produces output using formats that are easily transferred to and from different travel demand forecasting software packages.

It is expected that once it is operational, the airport demand allocation model will be able to be embedded in the application of the regional model. The airport model will be designed to read in congested highway and transit levels-of-service midway through the regional model feedback process, and it would then provide airport access/egress vehicle estimates that can be used for the remaining regional model traffic assignment runs.

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5 AIR PASSENGER DEMAND MODELING

As discussed above, the air passenger demand modeling component of the proposed model system is composed of two modules:

- Intercity trip generation model; and
- Intercity travel market demand model.

The following sections describe the design of these modules.

INTERCITY TRIP GENERATION MODEL

The intercity trip generation module will predict the number of intercity trips that will be generated in each airport model analysis zone. The module will relate forecast year total intercity trips to and from each zone to:

- Forecasts of zonal characteristics;
- Forecasts of traveler characteristics; and
- Forecasts of intercity trip levels-of-service:
  - Line-haul levels-of-service, such as air service frequency and fares;
  - Airport (and possibly other public intercity terminal) access levels-of service.

Model Design Options

Three different model forms for the trip generation model were considered:

- Aggregate zone trip generation model;
- Zone share model;
- Disaggregate trip frequency model.

These options are described below.

Aggregate Zone Trip Generation Model

For this approach, the available airport access survey data would be used to determine the number of intercity trips generated and attracted to each of the analysis zones for the base year. We would then estimate a model that relates the number of

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trips to and from the zones to aggregate zonal characteristics. The modeled relationships would then be applied to forecast year zonal estimates.

This type of model approach would likely entail the formulation of a group of market segment specific multiple regression models.

Zone Share Model

For this approach, we would first estimate the overall regional level of intercity tripmaking. We would then use the available airport access survey data to determine the number of intercity trips generated and attracted to each of the analysis zones for the base year, and develop a model that estimates the probability or share of total regional trips that come from specific zones based on the characteristics of the aggregate zonal characteristics.

This approach would require the development of two types of models. The regional total travel demand estimate is likely to be a set of regression models based on a combination of time-series travel volume data and base year cross-sectional travel data. The zone share forecast model would be formulated as a multinomial logit model with zonal size variables.

Disaggregate Trip Frequency Model

For this approach, we would need to identify one or more general population surveys (such as household surveys) that would provide data on the number of intercity trips being made by households in the region and/or by visitors to the region. We would then estimate a model that relates the number of intercity trips by households and visitors to the individual characteristics of those households and visitors. This model would then be applied to disaggregate forecasts of households and visitors.

A disaggregate trip frequency model would be formulated either as market segment specific cross-classification estimates (similar form to the regional model trip production equations), market segment specific multiple regression equations, or as logit equations in which the "choice variable" would be the number of intercity trips made by a household or visitor.

Selection of the Appropriate Model Form

Each of the model forms defined above has strengths and weaknesses. The trip frequency model has the advantage that it is a disaggregate approach. This means that the model outputs would feed more directly into the subsequent model components, which are expected to be in a disaggregate form. In addition, properly specified disaggregate models would be expected to have less bias during model application than similarly specified aggregate models.

On the other hand, the trip frequency approach requires more and different data than the other approaches do during model estimation, and a disaggregate approach necessarily requires the development of disaggregate household and visitor level forecasts for model application. The two aggregate approaches are still techniques that represent substantial analytical improvement over the airport demand modeling work done by other MPOs throughout the country, as most of these simply rely on distributing exogenous air travel forecasts throughout their region based on other regional (intracity) travel patterns.

Based on our review of data sources that are currently available, we recommend that we employ an aggregate modeling approach for trip generation. An aggregate approach will be the best way to fully utilize the significant amount of air traveler survey data that are currently available, and the aggregate approaches are more flexible than the disaggregate approach in terms of taking advantage of multiple types of survey data that are available for the different airports. We currently expect that the resident travel markets will best be modeled using the aggregate zone trip generation model formulation. The nonresident travel markets may best be modeled using a form of the zone share model.

The disaggregate approach requires data on residents' and visitors' intercity trip frequency. Data collected on intercepted trips do not allow us to analytically compare residents and visitors who do not make intercity trips. The Orange County airport passenger data collection effort included a telephone survey component, but non-travelers were screened out of the survey. In addition, although the LAX and Ontario passenger intercept surveys do ask respondents for their air trip frequency, the surveys do not collect any details about the non-intercepted trips, such as the trip purposes or air markets to which the trips were made.

Proposed Modeling Approach

The initial intercity trip generation models will focus on the development of a set of aggregate zone trip generation models based on the available airport passenger survey data and base year zone data. The model development effort will consist of:

- Preparation of air passenger survey data;
- Preparation of zonal data;

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- Model estimation; and
- Model validation.

The survey data preparation effort, which has already begun, will focus on cleaning and expanding the available survey data, combining the different datasets, and applying the survey geocoding to airport analysis zones. We will crosstabulate the air passenger survey datasets, and identify potential market segments and independent variables for the intercity trip generation models.

The zonal data preparation will include the combination of SCAG regional model base year zone data with year 2000 Census data to form a detailed airport analysis zone database. We will then add to this database estimates of hotel rooms by zones. The hotel room data will be compiled from visitor bureau databases and from other sources including the LAX and Ontario passenger surveys for which a fairly comprehensive list of hotels and motels was assembled. We will geocode the hotel addresses and assign them to the appropriate airport analysis zones. If the data are available, we will classify the hotels based on hotel quality ratings. This will allow the models to identify those facilities that are more likely to be used by air travelers.

At a minimum, the zone database used for trip generation model development will include:

- Total households;
- Total population;
- Total non-institutionalized population;
- Median household income;
- Household income zone quintile definitions;
- Households in regional income quintiles;
- Single-family / multi-family households;
- Employment by sector;
- Zone characteristics, such as density measures and dummy variables describing special traits of zones (CBD, Disneyland, etc.); and
- Zone airport access measures, such as distance to closest airport, highway travel times to nearest airport, and (for later model updates as they become available) the composite utilities from airport choice and access mode choice models.

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The model estimation process will entail positing different market segmentation schemes, and then seeking to build market segment specific multiple regression models that best explain intercity trip generation by zone. The market segmentation variable options include several different cross-classified trip related and traveler related characteristics collected in the airport passenger surveys, including:

- Trip purpose;
- Residency;
- Trip end type;
- Air market (non-Southern California trip end); and
- Number of nights away from home.

We will develop alternative regression models that relate the number of trips by market segment from each analysis zone to relevant characteristics of the zones. We will then select the best model specification based on goodness-of-fit statistics and the reasonability of the model coefficients.

If the initial aggregate trip generation models do not seem to adequately capture regional airport demand, we will seek to develop zone share models for some or all of the market segments. For these models, we will develop multinomial logit models that predict the probability that any given airport trip will come from each zone. These logit models will treat the zone characteristics as size variables.

When applied, these logit models will allocate the total number of airport trips to the analysis zones. A separate element of this model component will be used to forecast total air travel by market segment to and from the region. The initial form of this forecasting model will be a regression model developed based on annual historical travel and regional economic trends.

Regardless of the final model formats, the estimated models will be validated by applying the equations to the base year, and then comparing the model output to other available data sources, such as airport ground access counts and SCAG Regional Model outputs. We may also apply (or "backcast") the trip generation models to different past years to see whether the trip generation relationships appear to remain stable over time.

Future Trip Generation Model Enhancements

In the future, we may investigate ways to enhance the aggregate trip generation relationships or to convert the initial trip generation models to disaggregate models

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by taking advantage of soon-to-be-available survey data and potential additional data collection. SCAG's 2001 Travel Congestion Survey will include daily and two-day travel diary data for more than 20,000 households in the SCAG region. This dataset, which will be available in the next few months, should include information on those households' intercity travel during the diary day, as well as their within-region travel. Because intercity travel is not common, the diary data may not be sufficient for intercity trip generation modeling. The dataset will need to be evaluated for these purposes.

A second potential data source for developing disaggregate intercity trip generation models is the National Household Travel Survey (NHTS) dataset, which should also be available in a few months. NHTS collects travel diary data from a national sample of households, but it also includes respondent-reported retrospective data on intercity trips. The sample of Southern California households will be small, but this data source has the potential advantage of including information on visitors to the region. Again, the utility of the dataset will be evaluated as it becomes available.

The Los Angeles Convention and Visitors Bureau (LACVB) and other tourism bureaus conduct regular market research on visitors to the region. Depending on the data that can be obtained from these sources, it may be possible to further improve the trip generation models for visitors.

Finally, Phase 3 of the Airport Demand Model Development Project anticipates a major new data collection effort. These data collection activities could be structured to obtain the data needed for the development of disaggregate intercity trip generation models.

INTERCITY MARKET DEMAND MODEL

It is likely that the available survey data will not support a full set of air market specific trip generation models. Specific trip generation models may be possible for some air market for which a large number of surveys were collected, but we expect that we will need to rely primarily on overall trip generation equations that cover all the intercity markets. A separate model component will be necessary to divide the overall intercity trip generation from each zone into intercity market specific trip generation estimates.

An advantage of the inclusion of this model component is that it will improve our ability to make the model application tool flexible enough to allow users to override the trip generation model and provide external forecasts of overall intercity trips to and from the region or to and from each of the airports.

The intercity market demand model will forecast total travel to and from the different intercity markets as a function of:

- Total passengers for all intercity markets;
- Intercity service levels; and
- Characteristics of the intercity markets.

Market Definition

The first step in the development of this model component will be to define the intercity markets. The market definitions will include specific key origin-destination cities, groupings of origin-destination cities with similar service patterns, and groupings of origin-destination cities based on trip length and geographic region. Using US DOT ticket sample data and the results of the air passenger surveys, we will first identify the key origin-destination cities that will constitute individual markets by themselves. For instance, we expect that the Bay Area would be a market, and that Las Vegas would also constitute its own market

We will then use the Official Airline Guide database to classify the other cities based on the types and levels of service offered from each of the SCAG region airports. Several smaller east coast cities have limited direct service and significant levels of connecting service to and from LAX but have connecting service only from the other SCAG region airports. If these cities are unlikely to support direct service from the other regional airports, they cities may be pooled into a single analysis market. In defining the intercity markets, we will seek to anticipate potential airport model analyses. For instance, we may want to define the west coast markets so that they enable users to analyze potential high speed rail scenarios.

Model Design Options

The intercity market demand model can be formulated in several ways, including:

- Growth factor model based on historical changes in intercity market travel;
- Time series / cross-sectional models; or
- Destination market probability models.

These options are discussed below.

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Growth Factor Models

The most direct approach for forecasting the travel to and from intercity markets is to simply extrapolate the historical changes in travel to and from these markets. Growth factors would be calculated for each intercity travel market, and then the raw growth rates would be normalized to adhere to the predicted overall intercity trip generation.

This simple approach is straightforward to develop and apply, but it does not have a behavioral underpinning.

Time Series / Cross-Sectional Regression Models

Rather than extrapolating historical data, the historical travel data can be related to overall air travel levels for the intercity markets, and the socioeconomic and regional economic characteristics of the intercity markets. Under this approach, multiple regression models would be used to relate intercity trips by purpose and residency to:

- The projected overall air traffic growth for the intercity markets;
- The intercity markets' population, per capita income, and employment;
- The intercity transportation supply characteristics for travel to and from the intercity markets; and/or
- The geographic characteristics of the market areas.

The models could be developed as generic equations (covering all intercity markets) or market specific equations. Since these market variables are closely related to each other, the final model specifications may be robust with relatively few variables.

This approach seeks to define underlying characteristics that lead to intercity travel decisions, and to relate travel levels to these characteristics. However, it requires the assembly of data and forecasts for all intercity markets.

Destination Market Probability Models

Another formulation for the intercity market demand model would be to develop a multinomial choice model that predicts the share of intercity trips (by residency and purpose) that would come from and go to individual intercity travel markets. This model formulation would be similar to the generic time series/ cross-sectional regression model approach, except that the model equations would be multinomial logit models and the intercity market socioeconomic variables would act as size variables. The utility of traveling to each intercity market would be calculated and these utilities would predict the share of trips going to and from each market.

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This approach is a variation on the regression model approach. It may offer some modeling advantages over the regression equation approach if a generic model turns out to be the best overall approach. The data requirements are similar, but the model estimation and interpretation are slightly more complex.

Proposed Modeling Approach

We believe that the intercity market demand model should be formulated as either a set of time series / cross-sectional regression models or as a set of destination market probability models. Since the data requirements for these two model forms are equivalent, both types of models can be estimated and the best format can be selected. Unlike a growth factor approach, the proposed model forms seek to explain the differences in market size based on market characteristics, so at a minimum the effects of differential aviation growth in the travel market cities will be reflected in the forecasts.

As described above, the first step in this model development will be to define the core intercity markets so that all potential air destinations are assigned to one of a set of relatively homogenous markets. Once the markets have been defined, we will assemble base year estimates and forecasts of the regions for which the intercity market definitions correspond. The key variable in this respect will be estimates and forecasts of aviation growth in the intercity markets. The FAA's Terminal Area Forecasts provide a consistent set of data and forecasts that can be used to capture the differences in the projected growth in air travel among U.S. air markets. Other aviation sources, such as those published by aircraft manufacturers, include data and forecasts for international travel markets by broad geographic region.

We can augment the aviation growth estimates with publicly available and lower priced commercial estimates and forecasts of socioeconomic activity for the intercity markets. The aviation activity and socioeconomic database will then be expanded to include data on intercity service levels, such as average air fares and flights per day. These data will be compiled for the past several years from the Official Airline Guide and the U.S. DOT Origin-Destination Survey data. For forecast years, the service inputs will be developed from the air service module of the model system. The U.S. DOT ticket sample database will provide annual historical estimates of travel and average fares by intercity market. For specific markets, the travel estimates and the travel service level measures could be modified to include intercity rail trips, assuming these data are available and are currently significant enough to be included in the model.

The combined historical annual database will be used to statistically relate annual travel to and from intercity travel markets by residence to the markets' aviation activity, socioeconomic and travel level-of-service data. The regression model or logit model outputs will include goodness-of-fit measures, measures of each variable's contribution to the model's overall predictive ness, and statistical autocorrelation test results. We will use these measures and our assessment of the reasonableness of the model coefficients to select the best model specifications for use in the model system. We will then develop a straightforward model application tool so that forecasts of travel to intercity markets can be easily developed.

The model system's modular structure will permit users to refine the modeled relationships with more recent origin-destination data as they become available in the forthcoming years, and it will allow users to input alternative intercity market distributions. The modular structure will also allow users to input updated forecasts from the FAA, aircraft manufacturers, and others as they become available.

APPLICATION OF THE AIR PASSENGER DEMAND MODELING COMPONENT

The proposed two-module structure of the air passenger demand modeling component will allow the model user a great deal of flexibility with regard to incorporating independent exogenous forecasts of future air passenger demand.

The default model application protocol will be to forecast overall air passenger demand using the zone level intercity trip generation model, and then to allocate this total demand to the intercity travel markets. The resulting output of the process will be intercity demand forecasts for each intercity travel market by zone and by traveler market segment.

The model application process will also allow users to make use of independent exogenous forecasts. The model user will be able to replace the total number of intercity trips predicted by the trip generation model with an independent forecast of total intercity travel (perhaps from an airport planning or revenue bond study). The trip generation model would then be used to predict the distribution of trips by zone, while maintaining the total number of forecast trips. The intercity market demand model could then be applied to the independent forecast of total trips.

Alternatively, the user may have forecasts of travel by intercity market. In this case, the model application tool will allow the user to specify the market specific forecasts, and then it would determine the zonal share of the trips using the trip generation model while maintaining the total number of forecast trips.

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The two-module structure will also allow some flexibility in the model system's air service supply feedback procedures. The feedback loop could be used to affect total intercity travel by connecting air service supply measures to the intercity trip generation model, or alternatively, overall intercity demand (as calculated by the trip generation model or as supplied by independent forecasts) can be held constant, and the air service feedback loop could be used to affect the distribution of trips among intercity travel markets.

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6 AIRPORT ALLOCATION AND ACCESS MODELING

The output of the air passenger demand modeling component will be forecasts of intercity demand for each intercity travel market by zone and by traveler market segment. The airport allocation and access modeling component will take these demand forecasts and forecast which airports and types of air services will be used to complete those trips. This modeling component will also forecast the access mode choices of travelers. The choices of airport and airport access mode are closely related, and thus the two modules will be linked to each other.

The two modules of this model component, the airport / air service choice model, and the airport access mode choice model are described below.

AIRPORT / AIR SERVICE CHOICE MODEL

The airport / air service choice module will predict how the forecast year generated intercity trips will be distributed among airports and among air service types at the airports.[1] The module will seek to analyze the combined choice of airport and air service type because these decisions are currently (and likely will remain) highly correlated. For many intercity markets, the choice of a certain air service type will eliminate all but one or two airports from consideration, and alternatively, the choice of an airport will limit the air service types that can be chosen.

The module will predict forecast year intercity trips by airport and air service type based on:

- Forecast trips by zone and intercity market;
- Forecast year levels-of-service for intercity travel:
  - Air service frequency and fares by airport for each intercity travel market;
  - Airport access levels-of-service;
- Forecast year zonal / traveler characteristics.

[1] During model application, this module, like the other modules, may be extended to analyze the presence of non-air high-end intercity services, such as high speed rail or other modes that could compete for air passengers. In these cases, references to airports can be interpreted to include both airports and other high-end intercity terminals, and references to air service can be interpreted to include both air service and other high-end intercity service.

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Model Design Options

Although there are simplified aggregate methods that could be used to predict the share of total intercity travel at each airport, we recommend that this module of the model system be formulated as a set of market segment specific disaggregate multinomial or nested logit choice models.

Proposed Model Approach

To develop the airport / air service choice models, we will complete the following steps:

- Prepare the model estimation dataset:
  - Define air service types;
  - Assemble database of intercity travel levels-of-service;
  - Assemble database of airport access levels-of-service;
- Estimate and validate discrete choice models:
  - Select and test model variables;
  - Select and test model structure options; and
- Prepare the model application dataset.

Model Estimation Dataset Preparation

The choice set for the proposed discrete choice model will consist of the SCAG region airports cross-classified by air service types. The air service types could be defined in several ways. The initial air service type groupings will be defined based on airline type (e.g., low cost vs. standard airlines), airplane type (e.g., mainline jet, regional jet, turboprop), and connectivity (e.g., non-stop service vs. connecting service). We will use the Official Airline Guide and U.S. DOT sources to refine the air service types for each airport/intercity travel market combination.

We will assemble travel levels-of-service data (flight frequencies and fares) for each airport /air service type/ intercity travel market combination from the Official Airline Guide and U.S. DOT sources. We will also assemble airport access level-of-service data from each zone to each airport in the SCAG region. For the initial model development, these data will be developed by analyzing the SCAG regional model highway travel time estimates. Once the access mode choice model is developed, we will seek to use a composite multimodal measure of zone-to-airport impedance from that model in the airport / air service type model. This will be accomplished through the calculation of a logsum term from the mode choice model.

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Model Estimation and Validation

The estimation of the airport / air service type choice models will be an iterative process. Many different model specifications with various combinations of explanatory variables and model structures of different complexity will be tested until a set of final models is developed. The estimation process will begin by testing simple model specifications and as information about particular variables and variable forms is obtained, more complex model specifications and model structures will be tested.

The basic decisions in developing discrete choice models include:

- The selection of the variables to be included in the utility function for each choice along with the mathematical forms of each variable; and
- The selection of the appropriate model structure as allowed by the data and the nature of the choice behavior under study.

The utility functions in a discrete choice model that describe the attractiveness of each competing choice are usually linear combinations of variables that affect travelers' choices. The analyst provides a set of choice-specific utility equations, and then the model estimation software determines the relative importance of the different variables within those equations by assigning parameter values which best explain the actual choices that were made and that were reported in the survey data.

Model Variables

The variables that comprise the airport / air service type choice model utility functions can be classified into the following categories:

- Policy Variables – measures of key level-of-service attributes for each airport and air service type;
- Trip and Traveler Characteristics Variables – measures used to classify or segment different types of trips and travelers; and
- Alternative-Specific Constants – measures used to account for the average effects of variables that are not included in the policy variables or trip and traveler characteristics.

Each of these categories are discussed below, followed by a discussion of how one determines which variables are appropriate for particular models.

The inclusion of policy variables in a particular model specification accounts for those service attributes that reflect the attractiveness of an alternative. Intercity

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service frequency and fares, and access mode travel costs, travel times and frequency of service, are expected to affect the utility of a particular airport / air service type vis-à-vis the other choices for an individual traveler. Nevertheless, there are three basic choices in how these variables can be included in the model:

1. The functional form of the variable – Policy attributes can be represented by simple variables or by some mathematical transformation. For instance, travel time could be included in a model simply as travel time or as the logarithm of travel time;
2. The level of disaggregation – Policy attributes can be represented as aggregate measures of a particular variable or in a series of measures describing individual components of the attribute. For instance, a model could include one access mode travel time term or it could include separate terms for in-vehicle, out-of-vehicle, and wait times; and
3. Generic or alternative-specific representation – Policy attributes can be included in a model through the use of a single variable that applies to all choices or through a set of variables that apply to individual choices. For instance, a model could have a single coefficient for air service frequency or separate air service frequency coefficients for each airport / air service type.

Trip and traveler characteristics can be used in the models to account for important differences in choices among different types of trips and travelers. To be used in the airport / air service type models, these attributes need to be incorporated in one of the following three ways:

1. Separate models – If the variable is likely to have a large effect on the airport choice, it can be used as a means to define separate models. For instance, separate models could be developed for different trip purposes or by traveler residency.
2. Interactions with policy variables – The trip and traveler attributes can be related to one or more policy variables. For instance, separate air fare coefficients can be estimated for travelers in different income categories.
3. Alternative-specific representation – If the trip or traveler characteristic is likely to be related to a specific choice, the variable can be related specifically to that choice. For, instance, a model could include a lower-income constant term related to the choice of low-cost airlines.

Each of these approaches provides a different way of segmenting the market under study. The first approach provides a full segmentation with separate development of models. The second approach provides separate measures of policy variable

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coefficients, and, therefore, different utility equations with different marginal rates of substitution. The third approach attaches an additional constant term to a choice's utility to increase (or decrease) its attractiveness for the proper combination of traveler or trip characteristics.

The final type of variable used in a utility equation for the discrete choice model is the alternative-specific constant. Alternative-specific constants are used to capture the average contribution of the model's error terms to the different choices' utilities. The error terms represent factors that guide travelers' decisions and either cannot be captured through survey data or are not present in the model. The relative differences in these constants are often viewed as measures of how travelers would choose between available choices in an all-else-equal world.

In estimating discrete choice models, one alternative is arbitrarily chosen as a base choice. This option is assigned an alternative-specific constant of zero, and all the other choice constants are estimated in relation to this base mode. Airport / air service type choices with positive constants are on average more likely to be chosen than the base choice when all the model variables are included. Airport / air service type choices with negative coefficients are less likely to be chosen than the base choice, all else being equal.

The previous discussion describes the range of choices available for incorporating explanatory variables into a model system during model estimation. The model estimation process is a search process for determining a good combination of variables in their best forms. A model specification is identified and models are estimated. Based on the results of this effort, a new model specification is tested and the process continues until a preferred model specification is discovered.

The criteria for determining whether a model variable or group of variables should be retained in later model specifications and for evaluating the relative merits of alternative-specifications include the following:

- Appealing interpretation and predictive capability of the model coefficients in terms of proper signs and magnitudes;
- Overall ability of the model to fit the available choice data;
- Statistical precision of individual model coefficients;
- Marginal rates of substitution implied by the model parameters;

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- Predictive capability of the model coefficients in terms of the ability to forecast the independent variables; and
- Consistency with other models.

The most basic test of whether a model and its individual coefficients are satisfactory is whether the parameter estimates appear to be reasonable in terms of their effect on airport / air service type choice. For instance, a model that indicates that a travelers' utility increases with higher fares or longer airport access times is not satisfactory because it will lead to erroneous forecasts and policy decisions. For many variables, we often have strong prior knowledge of the expected signs and magnitudes. Counter-intuitive results usually mean that a particular model specification should be changed unless a reasonable rationale for the unexpected result is available.

The second evaluation criterion that can be considered in comparing model results is the overall fit of the model, as measured by the maximum likelihood estimation's log-likelihood measure. The log-likelihood of a model is a measure that determines how much of the variation in choices is being explained by a certain set of model parameters. Models can be easily compared through the calculation of a rho-squared statistic, which is the ratio of the improvement in log-likelihood to the initial likelihood for a particular specification.

The statistical precision of particular model coefficients is determined through the calculation of standard errors for all coefficients. The ratio of the coefficients to the standard errors (the "T" ratio) allows us to determine the degree of confidence with which we can state that a particular coefficient is different than zero. Model coefficients with high standard errors contribute less to the overall fit of the model and also tend to be less stable for forecasting purposes. Therefore, it is common to drop variables with low "T" ratios (high standard errors) from models.

Model Structure

The second basic choice in estimating the models is the selection of a model structure which is related to the functional form of the utility equations. Discrete choice analysis may be performed with a number of different model forms, but the most commonly used and most easily understood forms are the multinomial logit and nested logit models. As part of this study we will estimate both multinomial and nested models of airport / air service type choice.

The multinomial models can be estimated relatively easily using maximum likelihood estimation techniques, and they tell us a great deal about the tradeoffs that travelers make. Once we have developed a nearly final set of multinomial models

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and have narrowed the model variables to be considered in the model utility functions, we will begin to investigate nested model structures in more detail.

Nested model structures have appeal because they help to diminish the effects of a problematic property of the multinomial model structure known as independence from irrelevant alternatives (IIA). According to this property, the ratio of probabilities of choosing two alternatives is independent of the availability or attributes of any other alternatives. The consequence of this property is that increases in predicted selection of one airport / service type come at the expense of the other choices' selections in direct proportion to their existing share. Often, this simplification is unrealistic. Nested models seek to address this potential problem by allowing analysts to group choices that are expected to have a higher degree of substitution.

Validation

Discrete choice model validation is often overlooked, but will be a critical step in travel model development. The purpose of validation is to ensure that the model outputs are reasonable and accurate when evaluated in comparison to observed and known travel conditions and behavior. The general approach to validation will be to compare model results for the base year to U.S. DOT ticket sample data.

Model Application Dataset Preparation

The outputs of the passenger demand model component will be trip forecasts by zone and trip market segment. To apply the airport / air service choice model, we will further classify the base year and forecast year intercity trips on the basis of trip and traveler characteristics. The disaggregate model will be developed by relating the individual choices represented in the airport passenger surveys to the individual characteristics of the travelers and the trips that were intercepted in the survey. The model will then be applied to the forecast year database of individual travelers and trips.

AIRPORT ACCESS MODE CHOICE MODEL

The airport access mode choice modeling module will predict the forecast year airport access mode usage for trips from each zone to each airport. The model will relate future year access mode choices to:

- Forecast year total intercity trips between each zone and each airport;

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- Forecast year zonal / traveler characteristics; and
- Forecast year airport access levels-of-service by access mode.

Model Design Options

We believe that like the airport / air service type module, the airport access mode choice modeling module will best be formulated as a set of disaggregate discrete choice models. This will allow us to take advantage of traveler-specific variables to explain specific travel choices. The most advanced airport access mode choice models all use this model formulation.

A design option that can be considered is to combine the airport access mode choice model with the airport / air service type choice model by developing a nested choice model that incorporates all the choices into a single model. For the initial model estimation, we expect to develop separate models, but for later versions of the model system, we may investigate whether the choice prediction can be improved through the nesting of these different modules.

If the access utility (logsum) is used in the airport choice model then there is little difference in the model application between a nested model and separate models, and some implementation advantages to keeping the models separate. However, using a nested model for the calibration ensures that the implied values of time are consistent between the access mode choice and airport choice, since parameters for both parts of the model are estimated simultaneously.

Proposed Approach

The approach to developing the airport access mode choice model will be quite similar to that explained in detail above for the airport / air service type model. It will involve:

- Development of the model estimation dataset;
- Model estimation / validation; and
- Development of the model application dataset.

Perhaps the biggest challenge related to this module will be the development of the model estimation dataset. There are a large number of available airport access modes, and some are specific to airports. A further complication will be that the available survey data will require us to group like access services into meaningful mode definitions prior to model development.

We will develop mode-specific impedances for the airport access modes based on several sources, including:

- SCAG's regional model highway travel times;
- Published access mode schedules, fare tables, and operating procedures;
- Airport-specific data and estimates, such as:
  - Parking cost and availability limits;
  - Walking times related to various access modes.

Developing the levels-of-service for some modes may require alternative formulations that will need to be tested in the models. For instance, we will need to develop decision rules to translate available information into travel time estimates for shared-ride demand-responsive shuttle services. One passenger on one of these services may get a direct non-stop ride to the airport, while another may need to stop multiple times to pick up other passengers and take a circuitous route to the airport. We will also need to evaluate preliminary model results to determine the best way to reflect the times and costs associated with airport auto drop-off and pick-up trips.

The general model estimation and validation strategies described for the previous module also apply for this module. The access mode choice models will be estimated from the air passenger survey data and the access mode level-of-service database.

The model application issues for this module also mirror those of the previous module. We may need to further disaggregate the zone database to support the application of the disaggregate airport access mode choice models.

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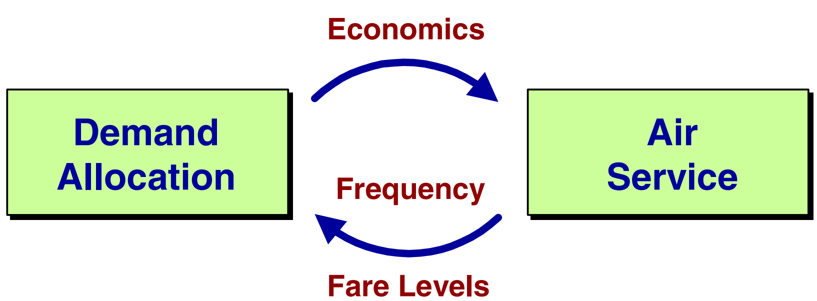
7

AIR SERVICE FORECASTING MODELS

The level and type of air service provided to specific destinations from the individual airports in Southern California represent central factors in the airport choice decisions made by passengers. The Service Forecasting module will be designed with the capability to generate initial service projections by air market, and then to incorporate a formal feedback mechanism between the level of air service at each commercial airport in the region and the passenger airport choice process. This process is illustrated by Figure 7.1.

Figure 7.1: Feedback Between Demand Allocation and Air Service



Most previous air passenger airport choice models have assumed that the levels of air service at each airport in the region being modeled are known. Where they are not known, as is generally the case when predicting the future allocation of passenger traffic to airports, then future air service levels at each airport are assumed, the air passenger demand is allocated to the airports based on these assumptions, and a check is performed to determine whether this allocation would support the assumed levels of air service. This test is typically performed by calculating the load factors implied by the resulting traffic in each market. If the assumed levels of air service are not consistent with the resulting distribution of air passenger demand, then the levels of air service are revised and the air passenger demand is reallocated. This process is repeated until a stable solution is reached.

The Regional Airport Demand Model will allow users to specify airport-specific service levels by air market, but it will also have the capability of generating internal forecasts. In air markets where nonstop services are currently provided from individual airports, it is likely that levels of flight frequency and seat capacity will

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tend to grow in line with the overall growth in regional demand to those markets. What is more difficult to predict are the decisions made by airlines to add new nonstop destinations from a particular airport in the region, or how airlines might elect to serve a new commercial airport, were one to be developed in the region. It is, however, clear that airlines will only elect to introduce new service at an airport when they expect the new services to be economically viable.

AIR SERVICE DEVELOPMENT CONSIDERATIONS

The success of new nonstop routes will be dependent on several factors, as described below:

- The overall level of passenger demand that exists in the region surrounding the airport to the air destination (and to potential markets that might be served beyond the nonstop destination);
- The share of this demand that would be attracted to the proposed service given competition from surrounding airports which in many instances will offer higher levels of flight frequency, and perhaps more airline choices, than would be available at the candidate airport; and
- The fare levels that could be realized on the proposed new services.

Examination of recent patterns of nonstop service at the Southern California airports and the associated distribution of O&D passenger demand among the region's airports provides useful insights that will help to guide the service development component of the model.

Regional Passenger Demand

Figure 7.2 ranks the Top 100 Domestic Origin-Destination markets for Southern California and shows the distribution of these passengers across the seven commercial airports in the region. These 100 markets exchanged 64.7 million domestic O&D passengers with Southern California during FY 2001, accounting for approximately 96 percent of total domestic passengers at the seven airports. The percentage distribution of LA region passengers across the six SCAG commercial airports is shown in Figure 7.3.

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Figure 7.2: Domestic O&D Passengers at the Southern California Airports – YE 2Q 01

Rank	Market	Code	Total O&D Psgrs	LA Region O&D Psgrs	LA Region Airports LAX	SNA	ONT	BUR	PSP	LGB	SAN
1	Oakland	OAK	4,714,690	3,908,680	1,614,230	756,910	650,040	877,840	9,660	0	806,010
2	Las Vegas	LAS	4,098,900	3,347,150	1,885,740	317,470	428,380	681,090	16,940	17,530	751,750
3	New York	NYC	4,014,360	3,462,840	2,955,470	268,770	162,920	14,800	55,950	4,930	551,520
4	San Jose	SJC	3,718,790	2,856,610	1,153,630	836,680	376,360	462,900	27,040	0	862,180
5	Phoenix	PHX	3,273,180	2,507,510	1,191,010	168,670	529,290	437,690	20,750	160,100	765,670
6	San Francisco	SFO	3,236,730	2,399,140	1,177,940	514,480	177,910	405,780	123,030	0	837,590
7	Sacramento	SAC	3,055,540	2,324,870	823,290	211,900	693,500	587,450	8,640	90	730,670
8	Seattle/Tacoma	SEA	2,774,900	2,231,500	1,062,260	485,290	293,090	260,960	128,780	1,120	543,400
9	Chicago	CHI	2,595,200	2,128,190	1,513,950	356,150	133,050	27,320	69,810	27,910	467,010
10	Portland	PDX	1,588,030	1,270,370	596,440	228,030	197,690	163,530	83,690	990	317,660
11	Denver	DEN	1,564,090	1,184,110	796,030	216,330	97,530	45,220	23,460	5,540	379,980
12	Dallas/Fort Worth	DFW	1,536,200	1,249,700	645,510	209,720	121,550	53,990	27,720	191,210	286,500
13	Salt Lake City	SLC	1,379,460	1,123,720	719,500	185,870	169,900	39,410	6,710	2,330	255,740
14	Washington	WAS	1,270,970	991,940	822,680	92,440	48,700	6,990	17,470	3,660	279,030
15	Honolulu	HNL	1,241,960	1,149,540	1,126,990	12,500	5,490	510	4,050	0	92,420
16	Atlanta	ATL	1,133,660	911,510	642,360	146,510	85,880	9,700	11,840	15,220	222,150
17	Baltimore	BWI	1,099,920	775,110	586,020	57,860	89,520	23,820	14,190	3,700	324,810
18	Houston	HOU	1,034,180	834,880	571,100	115,450	91,920	33,450	11,670	11,290	199,300
19	Boston	BOS	1,033,520	833,310	712,690	70,890	25,840	5,500	16,150	2,240	200,210
20	Minneapolis	MSP	946,960	713,750	498,240	114,710	67,390	4,930	23,900	4,580	233,210
21	Detroit	DTT	899,850	716,780	527,040	90,190	53,330	16,070	17,690	12,460	183,070
22	Philadelphia	PHL	845,460	647,760	529,160	68,410	27,770	5,130	14,040	3,250	197,700
23	Orlando	ORL	789,670	650,120	507,980	58,740	67,610	7,260	5,990	2,540	139,550
24	Reno	RNO	786,700	630,480	383,410	71,870	102,670	68,430	3,900	200	156,220
25	Tucson	TUS	712,770	508,330	425,030	12,440	38,630	17,240	1,880	13,110	204,440
26	Kansas City	MKC	619,300	472,080	311,990	61,590	61,000	18,400	13,840	5,260	147,220
27	St. Louis	STL	616,270	467,430	290,770	70,110	71,460	17,500	10,660	6,930	148,840
28	Albuquerque	ABQ	579,630	440,540	304,480	17,990	65,120	38,940	3,250	10,760	139,090
29	New Orleans	MSY	515,200	405,620	311,560	45,170	33,870	8,160	4,240	2,620	109,580
30	Kahului	OGG	479,630	452,030	442,860	4,570	1,640	210	2,750	0	27,600
31	Miami	MIA	475,220	419,810	367,540	26,590	17,240	2,330	4,850	1,260	55,410
32	Indianapolis	IND	458,150	361,600	248,990	40,890	48,600	10,040	9,270	3,810	96,550
33	Fort Lauderdale	FLL	445,280	354,670	259,070	44,020	39,150	4,660	6,140	1,630	90,610
34	Austin	AUS	436,860	324,780	207,110	50,550	36,700	19,620	6,070	4,730	112,080
35	Tampa	TPA	436,810	344,710	259,040	36,790	35,750	5,540	5,770	1,820	92,100
36	Cleveland	CLE	434,740	340,470	244,120	35,840	38,480	8,580	11,170	2,280	94,270
37	Nashville	BNA	390,570	310,630	212,470	26,890	56,260	9,960	4,310	740	79,940
38	Columbus	CMH	387,890	294,190	189,230	42,850	41,970	9,590	7,250	3,300	93,700
39	Hartford	HFD	371,040	277,130	191,120	34,120	33,690	6,360	9,810	2,030	93,910
40	San Antonio	SAT	363,840	283,680	172,970	35,970	48,780	16,790	4,440	4,730	80,160
41	Raleigh/Durham	RDU	355,280	256,200	181,810	26,340	35,760	5,360	5,490	1,440	99,080
42	Providence	PVD	328,930	228,290	168,550	31,410	19,060	4,340	4,690	240	100,640
43	Pittsburgh	PIT	302,960	227,970	168,990	40,740	12,180	530	4,540	990	74,990
44	El Paso	ELP	294,540	223,840	154,850	6,030	40,000	16,820	550	5,590	70,700
45	Milwaukee	MKE	291,780	232,840	183,730	18,190	17,280	1,600	7,920	4,120	58,940
46	Spokane	GEG	271,710	212,830	94,730	37,340	44,380	27,150	8,590	640	58,880
47	Omaha	OMA	269,620	201,820	124,760	23,910	31,830	9,540	8,950	2,830	67,800
48	Boise	BOI	251,360	200,580	117,420	26,410	36,260	15,920	4,170	400	50,780
49	Cincinnati	CVG	250,000	184,450	141,680	20,190	17,550	490	3,300	1,240	65,550
50	Charlotte	CLT	236,770	190,260	154,230	18,930	10,700	960	3,300	2,140	46,510
51	Los Angeles	LAX	218,490	69,330	0	9,280	9,940	50	50,060	0	149,160
52	Oklahoma City	OKC	211,750	159,920	85,120	24,680	33,050	12,060	3,730	1,280	51,830
53	Kona	KOA	195,080	181,240	177,740	1,370	1,030	110	990	0	13,840
54	Colorado Springs	COS	191,420	154,170	98,120	25,260	18,140	6,320	3,360	2,970	37,250
55	Tulsa	TUL	187,690	145,220	75,810	23,870	28,760	10,980	4,050	1,750	42,470
56	Manchester	MHT	182,190	118,050	87,200	18,860	9,550	1,100	1,280	60	64,140
57	Jacksonville	JAX	181,460	133,270	87,390	21,540	20,670	1,510	1,760	400	48,190
58	Louisville	SDF	178,310	136,260	75,710	32,380	21,760	3,990	2,110	310	42,050
59	Norfolk	ORF	171,570	95,220	66,810	14,490	11,180	680	1,520	540	76,350
60	Memphis	MEM	165,740	129,410	96,860	13,160	13,430	1,160	2,720	2,080	36,330

Source: US DOT, O&D Database, Database Products Inc.

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Aviation System Planning Consultant

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Figure 7-2 : *Continued*

Rank	Market	Code	Total O&D Psgrs	LA Region O&D Psgrs	LA Region Airports LAX	SNA	ONT	BUR	PSP	LGB	SAN
61	Albany	ALB	164,890	118,310	92,390	10,470	10,160	2,680	2,570	40	46,580
62	Anchorage	ANC	161,930	130,970	92,140	15,820	13,060	5,230	4,630	90	30,960
63	Buffalo	BUF	161,850	122,200	86,020	16,700	13,720	2,570	2,650	540	39,650
64	Kauai Island	LIH	151,870	139,100	135,310	2,400	610	80	700	0	12,770
65	San Diego	SAN	151,640	151,640	149,160	790	1,170	0	520	0	0
66	Birmingham	BHM	147,150	116,940	80,690	11,450	17,740	4,730	1,730	600	30,210
67	Fresno	FAT	143,130	114,840	92,600	10,100	8,240	680	2,910	310	28,290
68	Monterey	MRY	139,160	117,870	102,450	6,850	3,000	830	4,740	0	21,290
69	West Palm Beach	PBI	135,710	107,440	77,680	18,850	8,680	540	1,490	200	28,270
70	San Juan	SJU	134,400	115,500	104,260	5,840	4,050	160	1,010	180	18,900
71	Little Rock	LIT	126,610	96,660	59,510	8,620	20,630	4,540	1,830	1,530	29,950
72	Eugene	EUG	122,390	101,770	64,610	12,930	10,710	8,760	4,410	350	20,620
73	Richmond	RIC	110,240	80,380	53,250	15,860	7,680	710	2,300	580	29,860
74	Grand Rapids	GRR	104,590	81,010	51,890	16,120	8,760	260	3,720	260	23,580
75	Greensboro	GSO	94,630	70,610	49,290	10,690	8,660	280	1,230	460	24,020
76	Des Moines	DSM	90,680	69,360	42,140	11,380	8,510	2,490	3,510	1,330	21,320
77	Dayton	DAY	88,110	69,530	49,010	11,230	6,910	360	1,530	490	18,580
78	Rochester	ROC	85,070	64,880	42,520	13,580	6,600	70	1,890	220	20,190
79	Wichita	ICT	80,670	61,810	25,140	18,210	8,550	4,090	2,570	3,250	18,860
80	Medford	MFR	79,770	65,750	39,820	8,260	8,750	6,540	2,380	0	14,020
81	Madison	MSN	77,730	56,890	40,930	7,960	4,590	510	2,900	0	20,840
82	Islip	ISP	75,710	54,130	46,760	580	4,930	1,710	130	20	21,580
83	Syracuse	SYR	73,950	54,350	38,510	10,500	3,180	190	1,820	150	19,600
84	Fort Myers	FMY	65,180	49,610	35,930	8,150	4,510	70	870	80	15,570
85	Huntsville	HSV	64,300	52,090	32,470	11,490	6,400	420	750	560	12,210
86	Jackson	JAN	63,620	48,620	32,170	5,580	8,600	1,440	670	160	15,000
87	Charleston	CHS	60,590	41,470	30,260	6,600	4,260	40	310	0	19,120
88	Cedar Rapids	CID	60,010	43,420	24,020	9,080	5,860	2,770	1,470	220	16,590
89	Greenville/Spartanburg	GSP	56,740	44,450	26,590	10,890	5,470	270	1,070	160	12,290
90	Santa Barbara	SBA	55,430	43,650	40,080	1,680	710	0	1,180	0	11,780
91	Knoxville	TYS	55,330	41,980	26,060	8,440	5,830	510	870	270	13,350
92	Eureka	EKA	54,550	40,650	12,470	9,420	8,650	9,380	730	0	13,900
93	San Luis Obispo	CSL	53,600	43,150	38,120	2,470	1,600	0	960	0	10,450
94	Harrisburg	HAR	53,460	37,610	23,980	8,470	3,440	130	1,470	120	15,850
95	Palm Springs	PSP	50,880	50,360	50,060	300	0	0	0	0	520
96	Springfield	SGF	49,050	38,430	18,040	8,300	9,170	1,240	1,200	480	10,620
97	Sioux Falls	FSD	49,030	35,950	18,430	7,320	6,920	1,340	1,940	0	13,080
98	Savannah	SAV	48,290	37,750	25,240	6,190	4,630	100	800	790	10,540
99	Fayetteville	FYV	46,190	38,850	24,630	7,400	5,570	400	600	250	7,340
100	Santa Rosa	STS	45,770	39,720	33,160	3,230	1,770	480	1,080	0	6,050
Subtotal Top 100			64,726,670	51,278,140	31,930,320	7,036,800	6,070,460	4,620,960	1,040,990	578,610	13,448,530
All Other			2,995,980	2,280,390	1,477,490	363,540	283,000	79,680	62,070	14,610	715,590
Total			67,722,650	53,558,530	33,407,810	7,400,340	6,353,460	4,700,640	1,103,060	593,220	14,164,120

Source: US DOT, O&D Database, Database Products Inc.

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Aviation System Planning Consultant

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Figure 7.3: Domestic O&D Passenger Shares for LA Region Airports – YE 2Q 01

			Southern California	LA Region	Percent	Cum. Percent	Percent of Total LA Region Passengers					
Rank	Market	Code	O&D Psgrs	O&D Psgrs	of Total /1	of Total /1	LAX	SNA	ONT	BUR	PSP	LGB
1	Oakland	OAK	4,714,690	3,908,680	7.3%	7.3%	41.3%	19.4%	16.6%	22.5%	0.2%	0.0%
2	Las Vegas	LAS	4,098,900	3,347,150	6.2%	13.5%	56.3%	9.5%	12.8%	20.3%	0.5%	0.5%
3	New York	NYC	4,014,360	3,462,840	6.5%	20.0%	85.3%	7.8%	4.7%	0.4%	1.6%	0.1%
4	San Jose	SJC	3,718,790	2,856,610	5.3%	25.3%	40.4%	29.3%	13.2%	16.2%	0.9%	0.0%
5	Phoenix	PHX	3,273,180	2,507,510	4.7%	30.0%	47.5%	6.7%	21.1%	17.5%	0.8%	6.4%
6	San Francisco	SFO	3,236,730	2,399,140	4.5%	34.5%	49.1%	21.4%	7.4%	16.9%	5.1%	0.0%
7	Sacramento	SAC	3,055,540	2,324,870	4.3%	38.8%	35.4%	9.1%	29.8%	25.3%	0.4%	0.0%
8	Seattle/Tacoma	SEA	2,774,900	2,231,500	4.2%	43.0%	47.6%	21.7%	13.1%	11.7%	5.8%	0.1%
9	Chicago	CHI	2,595,200	2,128,190	4.0%	47.0%	71.1%	16.7%	6.3%	1.3%	3.3%	1.3%
10	Portland	PDX	1,588,030	1,270,370	2.4%	49.4%	47.0%	17.9%	15.6%	12.9%	6.6%	0.1%
11	Denver	DEN	1,564,090	1,184,110	2.2%	51.6%	67.2%	18.3%	8.2%	3.8%	2.0%	0.5%
12	Dallas/Fort Worth	DFW	1,536,200	1,249,700	2.3%	53.9%	51.7%	16.8%	9.7%	4.3%	2.2%	15.3%
13	Salt Lake City	SLC	1,379,460	1,123,720	2.1%	56.0%	64.0%	16.5%	15.1%	3.5%	0.6%	0.2%
14	Washington	WAS	1,270,970	991,940	1.9%	57.9%	82.9%	9.3%	4.9%	0.7%	1.8%	0.4%
15	Honolulu	HNL	1,241,960	1,149,540	2.1%	60.0%	98.0%	1.1%	0.5%	0.0%	0.4%	0.0%
16	Atlanta	ATL	1,133,660	911,510	1.7%	61.7%	70.5%	16.1%	9.4%	1.1%	1.3%	1.7%
17	Baltimore	BWI	1,099,920	775,110	1.4%	63.2%	75.6%	7.5%	11.5%	3.1%	1.8%	0.5%
18	Houston	HOU	1,034,180	834,880	1.6%	64.7%	68.4%	13.8%	11.0%	4.0%	1.4%	1.4%
19	Boston	BOS	1,033,520	833,310	1.6%	66.3%	85.5%	8.5%	3.1%	0.7%	1.9%	0.3%
20	Minneapolis	MSP	946,960	713,750	1.3%	67.6%	69.8%	16.1%	9.4%	0.7%	3.3%	0.6%
21	Detroit	DTT	899,850	716,780	1.3%	68.9%	73.5%	12.6%	7.4%	2.2%	2.5%	1.7%
22	Philadelphia	PHL	845,460	647,760	1.2%	70.1%	81.7%	10.6%	4.3%	0.8%	2.2%	0.5%
23	Orlando	ORL	789,670	650,120	1.2%	71.4%	78.1%	9.0%	10.4%	1.1%	0.9%	0.4%
24	Reno	RNO	786,700	630,480	1.2%	72.5%	60.8%	11.4%	16.3%	10.9%	0.6%	0.0%
25	Tucson	TUS	712,770	508,330	0.9%	73.5%	83.6%	2.4%	7.6%	3.4%	0.4%	2.6%
26	Kansas City	MKC	619,300	472,080	0.9%	74.4%	66.1%	13.0%	12.9%	3.9%	2.9%	1.1%
27	St. Louis	STL	616,270	467,430	0.9%	75.2%	62.2%	15.0%	15.3%	3.7%	2.3%	1.5%
28	Albuquerque	ABQ	579,630	440,540	0.8%	76.1%	69.1%	4.1%	14.8%	8.8%	0.7%	2.4%
29	New Orleans	MSY	515,200	405,620	0.8%	76.8%	76.8%	11.1%	8.4%	2.0%	1.0%	0.6%
30	Kahului	OGG	479,630	452,030	0.8%	77.7%	98.0%	1.0%	0.4%	0.0%	0.6%	0.0%
31	Miami	MIA	475,220	419,810	0.8%	78.4%	87.5%	6.3%	4.1%	0.6%	1.2%	0.3%
32	Indianapolis	IND	458,150	361,600	0.7%	79.1%	68.9%	11.3%	13.4%	2.8%	2.6%	1.1%
33	Fort Lauderdale	FLL	445,280	354,670	0.7%	79.8%	73.0%	12.4%	11.0%	1.3%	1.7%	0.5%
34	Austin	AUS	436,860	324,780	0.6%	80.4%	63.8%	15.6%	11.3%	6.0%	1.9%	1.5%
35	Tampa	TPA	436,810	344,710	0.6%	81.0%	75.1%	10.7%	10.4%	1.6%	1.7%	0.5%
36	Cleveland	CLE	434,740	340,470	0.6%	81.7%	71.7%	10.5%	11.3%	2.5%	3.3%	0.7%
37	Nashville	BNA	390,570	310,630	0.6%	82.3%	68.4%	8.7%	18.1%	3.2%	1.4%	0.2%
38	Columbus	CMH	387,890	294,190	0.5%	82.8%	64.3%	14.6%	14.3%	3.3%	2.5%	1.1%
39	Hartford	HFD	371,040	277,130	0.5%	83.3%	69.0%	12.3%	12.2%	2.3%	3.5%	0.7%
40	San Antonio	SAT	363,840	283,680	0.5%	83.8%	61.0%	12.7%	17.2%	5.9%	1.6%	1.7%
41	Raleigh/Durham	RDU	355,280	256,200	0.5%	84.3%	71.0%	10.3%	14.0%	2.1%	2.1%	0.6%
42	Providence	PVD	328,930	228,290	0.4%	84.8%	73.8%	13.8%	8.3%	1.9%	2.1%	0.1%
43	Pittsburgh	PIT	302,960	227,970	0.4%	85.2%	74.1%	17.9%	5.3%	0.2%	2.0%	0.4%
44	El Paso	ELP	294,540	223,840	0.4%	85.6%	69.2%	2.7%	17.9%	7.5%	0.2%	2.5%
45	Milwaukee	MKE	291,780	232,840	0.4%	86.0%	78.9%	7.8%	7.4%	0.7%	3.4%	1.8%
46	Spokane	GEG	271,710	212,830	0.4%	86.4%	44.5%	17.5%	20.9%	12.8%	4.0%	0.3%
47	Omaha	OMA	269,620	201,820	0.4%	86.8%	61.8%	11.8%	15.8%	4.7%	4.4%	1.4%
48	Boise	BOI	251,360	200,580	0.4%	87.2%	58.5%	13.2%	18.1%	7.9%	2.1%	0.2%
49	Cincinnati	CVG	250,000	184,450	0.3%	87.5%	76.8%	10.9%	9.5%	0.3%	1.8%	0.7%
50	Charlotte	CLT	236,770	190,260	0.4%	87.9%	81.1%	9.9%	5.6%	0.5%	1.7%	1.1%
51	Los Angeles	LAX	218,490	69,330	0.1%	88.0%	0.0%	13.4%	14.3%	0.1%	72.2%	0.0%
52	Oklahoma City	OKC	211,750	159,920	0.3%	88.3%	53.2%	15.4%	20.7%	7.5%	2.3%	0.8%
53	Kona	KOA	195,080	181,240	0.3%	88.6%	98.1%	0.8%	0.6%	0.1%	0.5%	0.0%
54	Colorado Springs	COS	191,420	154,170	0.3%	88.9%	63.6%	16.4%	11.8%	4.1%	2.2%	1.9%
55	Tulsa	TUL	187,690	145,220	0.3%	89.2%	52.2%	16.4%	19.8%	7.6%	2.8%	1.2%
56	Manchester	MHT	182,190	118,050	0.2%	89.4%	73.9%	16.0%	8.1%	0.9%	1.1%	0.1%
57	Jacksonville	JAX	181,460	133,270	0.2%	89.7%	65.6%	16.2%	15.5%	1.1%	1.3%	0.3%
58	Louisville	SDF	178,310	136,260	0.3%	89.9%	55.6%	23.8%	16.0%	2.9%	1.5%	0.2%
59	Norfolk	ORF	171,570	95,220	0.2%	90.1%	70.2%	15.2%	11.7%	0.7%	1.6%	0.6%
60	Memphis	MEM	165,740	129,410	0.2%	90.3%	74.8%	10.2%	10.4%	0.9%	2.1%	1.6%

/1: For LA Region Only
Source: US DOT, O&D Database, Database Products Inc.

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Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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Figure 7-3 : *Continued*

Rank	Market	Code	Southern California O&D Psgrs	LA Region O&D Psgrs	Percent of Total /1	Cum. Percent of Total /1	Percent of Total LA Region Passengers					
							LAX	SNA	ONT	BUR	PSP	LGB
61	Albany	ALB	164,890	118,310	0.2%	90.6%	78.1%	8.8%	8.6%	2.3%	2.2%	0.0%
62	Anchorage	ANC	161,930	130,970	0.2%	90.8%	70.4%	12.1%	10.0%	4.0%	3.5%	0.1%
63	Buffalo	BUF	161,850	122,200	0.2%	91.0%	70.4%	13.7%	11.2%	2.1%	2.2%	0.4%
64	Kauai Island	LIH	151,870	139,100	0.3%	91.3%	97.3%	1.7%	0.4%	0.1%	0.5%	0.0%
65	San Diego	SAN	151,640	151,640	0.3%	91.6%	98.4%	0.5%	0.8%	0.0%	0.3%	0.0%
66	Birmingham	BHM	147,150	116,940	0.2%	91.8%	69.0%	9.8%	15.2%	4.0%	1.5%	0.5%
67	Fresno	FAT	143,130	114,840	0.2%	92.0%	80.6%	8.8%	7.2%	0.6%	2.5%	0.3%
68	Monterey	MRY	139,160	117,870	0.2%	92.2%	86.9%	5.8%	2.5%	0.7%	4.0%	0.0%
69	West Palm Beach	PBI	135,710	107,440	0.2%	92.4%	72.3%	17.5%	8.1%	0.5%	1.4%	0.2%
70	San Juan	SJU	134,400	115,500	0.2%	92.7%	90.3%	5.1%	3.5%	0.1%	0.9%	0.2%
71	Little Rock	LIT	126,610	96,660	0.2%	92.8%	61.6%	8.9%	21.3%	4.7%	1.9%	1.6%
72	Eugene	EUG	122,390	101,770	0.2%	93.0%	63.5%	12.7%	10.5%	8.6%	4.3%	0.3%
73	Richmond	RIC	110,240	80,380	0.2%	93.2%	66.2%	19.7%	9.6%	0.9%	2.9%	0.7%
74	Grand Rapids	GRR	104,590	81,010	0.2%	93.3%	64.1%	19.9%	10.8%	0.3%	4.6%	0.3%
75	Greensboro	GSO	94,630	70,610	0.1%	93.5%	69.8%	15.1%	12.3%	0.4%	1.7%	0.7%
76	Des Moines	DSM	90,680	69,360	0.1%	93.6%	60.8%	16.4%	12.3%	3.6%	5.1%	1.9%
77	Dayton	DAY	88,110	69,530	0.1%	93.7%	70.5%	16.2%	9.9%	0.5%	2.2%	0.7%
78	Rochester	ROC	85,070	64,880	0.1%	93.8%	65.5%	20.9%	10.2%	0.1%	2.9%	0.3%
79	Wichita	ICT	80,670	61,810	0.1%	94.0%	40.7%	29.5%	13.8%	6.6%	4.2%	5.3%
80	Medford	MFR	79,770	65,750	0.1%	94.1%	60.6%	12.6%	13.3%	9.9%	3.6%	0.0%
81	Madison	MSN	77,730	56,890	0.1%	94.2%	71.9%	14.0%	8.1%	0.9%	5.1%	0.0%
82	Islip	ISP	75,710	54,130	0.1%	94.3%	86.4%	1.1%	9.1%	3.2%	0.2%	0.0%
83	Syracuse	SYR	73,950	54,350	0.1%	94.4%	70.9%	19.3%	5.9%	0.3%	3.3%	0.3%
84	Fort Myers	FMY	65,180	49,610	0.1%	94.5%	72.4%	16.4%	9.1%	0.1%	1.8%	0.2%
85	Huntsville	HSV	64,300	52,090	0.1%	94.6%	62.3%	22.1%	12.3%	0.8%	1.4%	1.1%
86	Jackson	JAN	63,620	48,620	0.1%	94.7%	66.2%	11.5%	17.7%	3.0%	1.4%	0.3%
87	Charleston	CHS	60,590	41,470	0.1%	94.7%	73.0%	15.9%	10.3%	0.1%	0.7%	0.0%
88	Cedar Rapids	CID	60,010	43,420	0.1%	94.8%	55.3%	20.9%	13.5%	6.4%	3.4%	0.5%
89	Greenville/Spartanburg	GSP	56,740	44,450	0.1%	94.9%	59.8%	24.5%	12.3%	0.6%	2.4%	0.4%
90	Santa Barbara	SBA	55,430	43,650	0.1%	95.0%	91.8%	3.8%	1.6%	0.0%	2.7%	0.0%
91	Knoxville	TYS	55,330	41,980	0.1%	95.1%	62.1%	20.1%	13.9%	1.2%	2.1%	0.6%
92	Eureka	EKA	54,550	40,650	0.1%	95.1%	30.7%	23.2%	21.3%	23.1%	1.8%	0.0%
93	San Luis Obispo	CSL	53,600	43,150	0.1%	95.2%	88.3%	5.7%	3.7%	0.0%	2.2%	0.0%
94	Harrisburg	HAR	53,460	37,610	0.1%	95.3%	63.8%	22.5%	9.1%	0.3%	3.9%	0.3%
95	Palm Springs	PSP	50,880	50,360	0.1%	95.4%	99.4%	0.6%	0.0%	0.0%	0.0%	0.0%
96	Springfield	SGF	49,050	38,430	0.1%	95.5%	46.9%	21.6%	23.9%	3.2%	3.1%	1.2%
97	Sioux Falls	FSD	49,030	35,950	0.1%	95.5%	51.3%	20.4%	19.2%	3.7%	5.4%	0.0%
98	Savannah	SAV	48,290	37,750	0.1%	95.6%	66.9%	16.4%	12.3%	0.3%	2.1%	2.1%
99	Fayetteville	FYV	46,190	38,850	0.1%	95.7%	63.4%	19.0%	14.3%	1.0%	1.5%	0.6%
100	Santa Rosa	STS	45,770	39,720	0.1%	95.7%	83.5%	8.1%	4.5%	1.2%	2.7%	0.0%
	Subtotal Top 100		64,726,670	51,278,140	95.7%	95.7%	62.3%	13.7%	11.8%	9.0%	2.0%	1.1%
	All Other		2,995,980	2,280,390	4.3%	100.0%	64.8%	15.9%	12.4%	3.5%	2.7%	0.6%
	Total		67,722,650	53,558,530	100.0%		62.4%	13.8%	11.9%	8.8%	2.1%	1.1%

/1: For LA Region Only
Source: US DOT, O&D Database, Database Products Inc.

Regional Air Services

Figure 7.4 shows the numbers of daily nonstop flights from each Southern California airport to the Top 100 O&D destinations. In February 2001, these 100 destinations accounted for 1,501 daily domestic flights from Southern California airports, or 94 percent of total scheduled domestic departures from the region.

CAMBRIDGE SYSTEMATICS INC.

Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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Figure 7-4: Domestic O&D Passengers and Daily Departures for Southern California Airports – YE 2Q 01

O&D Rank	Market	Code	So. Cal. PDEW	Total Daily N/S Depts	# of Apts w/ N/S Service LA Reg.	# of Apts w/ N/S Service So. Cal.	Average A/C Size	Daily Departures by Aiport, February 2001 LAX	SNA	ONT	BUR	PSP	LGB	SAN
1	Oakland	OAK	6,458	77	4	5	131	36	12	14	15	0	0	11
2	Las Vegas	LAS	5,615	90	6	7	138	57	8	11	12	1	1	16
3	New York	NYC	5,499	46	3	4	189	41	4	1	0	0	0	6
4	San Jose	SJC	5,094	64	5	6	133	33	15	7	8	1	0	15
5	Phoenix	PHX	4,484	102	6	7	132	46	9	22	13	7	5	23
6	San Francisco	SFO	4,434	81	5	6	124	46	12	6	12	5	0	20
7	Sacramento	SAC	4,186	40	4	5	135	14	5	11	10	0	0	11
8	Seattle/Tacoma	SEA	3,801	40	5	6	139	21	9	4	3	3	0	8
9	Chicago	CHI	3,555	50	4	5	159	36	10	2	0	2	0	12
10	Portland	PDX	2,175	25	5	6	133	15	3	3	3	1	0	4
11	Denver	DEN	2,143	33	5	6	158	20	6	4	2	1	0	10
12	Dallas/Fort Worth	DFW	2,104	55	6	7	140	27	11	8	2	3	4	12
13	Salt Lake City	SLC	1,890	23	4	5	150	14	5	3	0	1	0	5
14	Washington	WAS	1,741	15	1	2	169	15	0	0	0	0	0	3
15	Honolulu	HNL	1,701	16	1	1	281	16	0	0	0	0	0	0
16	Atlanta	ATL	1,553	14	3	4	216	10	3	1	0	0	0	5
17	Baltimore	BWI	1,507	5	1	1	143	5	0	0	0	0	0	0
18	Houston	HOU	1,417	23	4	5	145	15	5	2	0	1	0	5
19	Boston	BOS	1,416	11	1	2	186	11	0	0	0	0	0	1
20	Minneapolis	MSP	1,297	14	4	5	150	8	3	2	0	1	0	5
21	Detroit	DTT	1,233	7	2	3	188	6	1	0	0	0	0	2
22	Philadelphia	PHL	1,158	8	1	2	127	8	0	0	0	0	0	2
23	Orlando	ORL	1,082	6	1	1	175	6	0	0	0	0	0	0
24	Reno	RNO	1,078	10	1	1	129	10	0	0	0	0	0	0
25	Tucson	TUS	976	9	1	2	132	9	0	0	0	0	0	3
26	Kansas City	MKC	848	7	1	2	134	7	0	0	0	0	0	1
27	St. Louis	STL	844	14	3	4	156	10	2	2	0	0	0	4
28	Albuquerque	ABQ	794	6	1	2	137	6	0	0	0	0	0	4
29	New Orleans	MSY	706	3	1	2	141	3	0	0	0	0	0	1
30	Kahului	OGG	657	6	1	1	222	6	0	0	0	0	0	0
31	Miami	MIA	651	8	1	1	159	8	0	0	0	0	0	0
32	Indianapolis	IND	628	1	1	1	137	1	0	0	0	0	0	0
33	Fort Lauderdale	FLL	610	1	1	1	176	1	0	0	0	0	0	0
34	Austin	AUS	598	3	1	2	133	3	0	0	0	0	0	1
35	Tampa	TPA	598	2	1	1	187	2	0	0	0	0	0	0
36	Cleveland	CLE	596	4	1	1	124	4	0	0	0	0	0	0
37	Nashville	BNA	535	5	2	3	136	4	0	1	0	0	0	2
38	Columbus	CMH	531	1	1	1	148	1	0	0	0	0	0	0
39	Hartford	HFD	508	1	1	1	146	1	0	0	0	0	0	0
40	San Antonio	SAT	498	2	1	1	146	2	0	0	0	0	0	0
41	Raleigh/Durham	RDU	487	0				0	0	0	0	0	0	0
42	Providence	PVD	451	0				0	0	0	0	0	0	0
43	Pittsburgh	PIT	415	7	2	3	169	5	2	0	0	0	0	3
44	El Paso	ELP	403	6	1	2	137	6	0	0	0	0	0	2
45	Milwaukee	MKE	400	2	1	1	112	2	0	0	0	0	0	0
46	Spokane	GEG	372	0				0	0	0	0	0	0	0
47	Omaha	OMA	369	2	1	1	84	2	0	0	0	0	0	0
48	Boise	BOI	344	3	1	1	72	3	0	0	0	0	0	0
49	Cincinnati	CVG	342	4	1	2	195	4	0	0	0	0	0	2
50	Charlotte	CLT	324	4	1	2	122	4	0	0	0	0	0	2
51	Los Angeles	LAX	299	61	3	4	35	0	16	12	0	33	0	66
52	Oklahoma City	OKC	290	0				0	0	0	0	0	0	0
53	Kona	KOA	267	3	1	1	181	3	0	0	0	0	0	0
54	Colorado Springs	COS	262	3	1	1	129	3	0	0	0	0	0	0
55	Tulsa	TUL	257	1	1	1	129	1	0	0	0	0	0	0
56	Manchester	MHT	250	0				0	0	0	0	0	0	0
57	Jacksonville	JAX	249	0				0	0	0	0	0	0	0
58	Louisville	SDF	244	0				0	0	0	0	0	0	0
59	Norfolk	ORF	235	0				0	0	0	0	0	0	0
60	Memphis	MEM	227	4	1	2	157	4	0	0	0	0	0	1

Source: US DOT, O&D Database, Database Products Inc. and OAG Schedule Tapes, Feb 2001.

Figure 7-4 : *Continued*

O&D Rank	Market	Code	So. Cal. PDEW	Total Daily N/S Depts	# of Apts w/ N/S Service LA Reg.	So. Cal.	Average A/C Size	Daily Departures by Aiport, February 2001 LAX	SNA	ONT	BUR	PSP	LGB	SAN
61	Albany	ALB	226	0				0	0	0	0	0	0	0
62	Anchorage	ANC	222	1	1	1	137	1	0	0	0	0	0	0
63	Buffalo	BUF	222	0				0	0	0	0	0	0	0
64	Kauai Island	LIH	208	1	1	1	182	1	0	0	0	0	0	0
65	San Diego	SAN	208	66	1	1	37	66	0	0	0	0	0	0
66	Birmingham	BHM	202	0				0	0	0	0	0	0	0
67	Fresno	FAT	196	25	1	1	31	25	0	0	0	0	0	0
68	Monterey	MRY	191	22	1	1	31	22	0	0	0	0	0	0
69	West Palm Beach	PBI	186	0				0	0	0	0	0	0	0
70	San Juan	SJU	184	1	1	1	180	1	0	0	0	0	0	0
71	Little Rock	LIT	173	0				0	0	0	0	0	0	0
72	Eugene	EUG	168	3	1	1	72	3	0	0	0	0	0	0
73	Richmond	RIC	151	0				0	0	0	0	0	0	0
74	Grand Rapids	GRR	143	0				0	0	0	0	0	0	0
75	Greensboro	GSO	130	0				0	0	0	0	0	0	0
76	Des Moines	DSM	124	0				0	0	0	0	0	0	0
77	Dayton	DAY	121	0				0	0	0	0	0	0	0
78	Rochester	ROC	117	0				0	0	0	0	0	0	0
79	Wichita	ICT	111	0				0	0	0	0	0	0	0
80	Medford	MFR	109	1	1	1	108	1	0	0	0	0	0	0
81	Madison	MSN	106	0				0	0	0	0	0	0	0
82	Islip	ISP	104	0				0	0	0	0	0	0	0
83	Syracuse	SYR	101	0				0	0	0	0	0	0	0
84	Fort Myers	FMY	89	0				0	0	0	0	0	0	0
85	Huntsville	HSV	88	0				0	0	0	0	0	0	0
86	Jackson	JAN	87	0				0	0	0	0	0	0	0
87	Charleston	CHS	83	0				0	0	0	0	0	0	0
88	Cedar Rapids	CID	82	0				0	0	0	0	0	0	0
89	Greenville/Spartanburg	GSP	78	0				0	0	0	0	0	0	0
90	Santa Barbara	SBA	76	30	1	1	31	30	0	0	0	0	0	0
91	Knoxville	TYS	76	0				0	0	0	0	0	0	0
92	Eureka	EKA	75	0				0	0	0	0	0	0	0
93	San Luis Obispo	CSL	73	18	1	1	31	18	0	0	0	0	0	0
94	Harrisburg	HAR	73	0				0	0	0	0	0	0	0
95	Palm Springs	PSP	70	33	1	1	34	33	0	0	0	0	0	0
96	Springfield	SGF	67	0				0	0	0	0	0	0	0
97	Sioux Falls	FSD	67	0				0	0	0	0	0	0	0
98	Savannah	SAV	66	0				0	0	0	0	0	0	0
99	Fayetteville	FYV	63	0				0	0	0	0	0	0	0
100	Santa Rosa	STS	63	4	1	1	30	4	0	0	0	0	0	0
	Subtotal Top 100		88,667	1,233			121	826	141	116	80	60	10	268
	All Other		4,104	92			34	91	0	0	0	0	1	1
	Total		92,771	1,325			116	917	141	116	80	60	11	269
	No. of N/S Markets Served													
	Top 20							20	16	16	10	12	3	18
	Top 50							47	19	18	10	12	3	31
	Top 100							63	20	19	10	13	3	33
	All Domestic Markets							77	20	19	10	13	4	34

Source: US DOT, O&D Database, Database Products Inc. and OAG Schedule Tapes, Feb 2001.

Figure 7.4 also shows the variation in the number of regional airports that receive nonstop service to specific destinations based on the total O&D passengers from the region. As would be expected, the highest passenger density markets receive nonstop service from most of the commercial airports in the region. Three major O&D markets — Las Vegas, Phoenix, and Dallas/Ft. Worth — which also represent significant connecting hubs/focus cities in the networks of Southwest Airlines, America West and American Airlines, receive nonstop service from each of the six LA region airports and San Diego. The Bay Area airports of Oakland, San Jose, and

Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

San Francisco, which in FY 2001 accounted for a combined 9.2 million O&D passengers from the SCAG region airports (or approximately 17 percent of the region's total domestic traffic) received service from 4 or 5 of the six SCAG commercial airports and all were served from San Diego.

The 13 largest domestic markets each generated more than 1.3 million annual O&D passengers to and from Southern California airports, and all of these markets were served from at least 4 of the SCAG region commercial airports in addition to San Diego. The next largest domestic markets—Washington DC and Honolulu—account for 1.2 to 1.3 million annual passengers, but received nonstop service to only one of the SCAG commercial airports (LAX), while San Diego received nonstop service to Washington only. The defining characteristic of these two markets is their distance from the LA region—both are long-haul markets of greater than 2,200 miles.

Of all remaining domestic markets, with the exception of LAX itself, the only destinations that receive nonstop service from airports other than LAX or San Diego are carrier connecting hubs or focus cities including Atlanta, Houston, Minneapolis, Detroit, St. Louis, Nashville and Pittsburgh. These markets support service from multiple airports in the LA region, while other markets of similar O&D size do not, because of their ability to flow passengers to other destinations beyond the hub.

Relationship Between Passenger Demand and Air Service

The relationship between O&D passenger volume and the number of LA region airports (excluding San Diego) that receive nonstop service is displayed graphically in Figure 7.5. Carrier hubs and focus cities, displayed in blue, are located above the trend line indicating that they receive service from more of the region's airports than would be expected based on their O&D passenger volume. Conversely, destinations such as Orlando, Boston, Washington, Honolulu, and New York City fall below the trend line, suggesting that long-haul markets receive service to fewer airports than might be anticipated based on O&D passenger volume alone.

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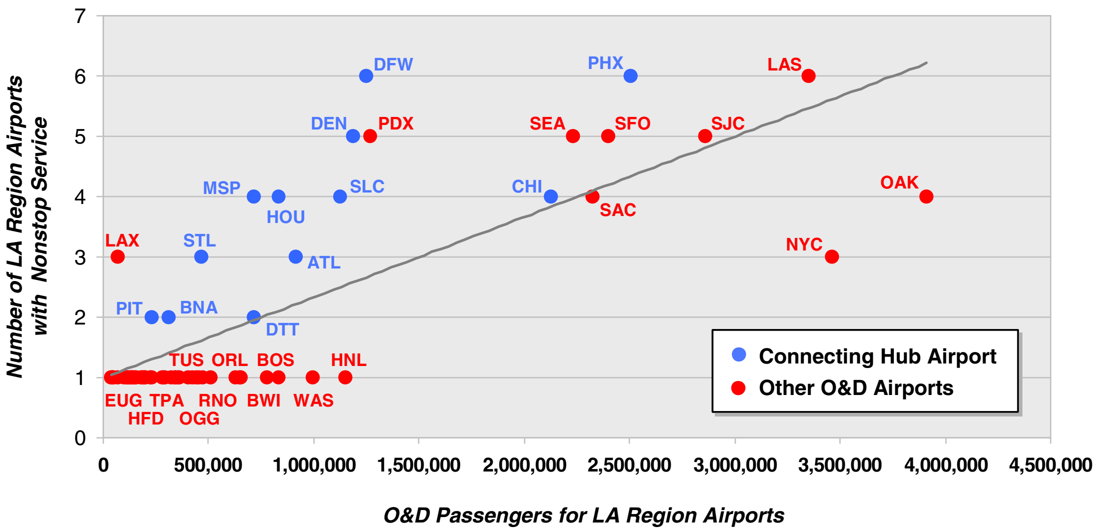
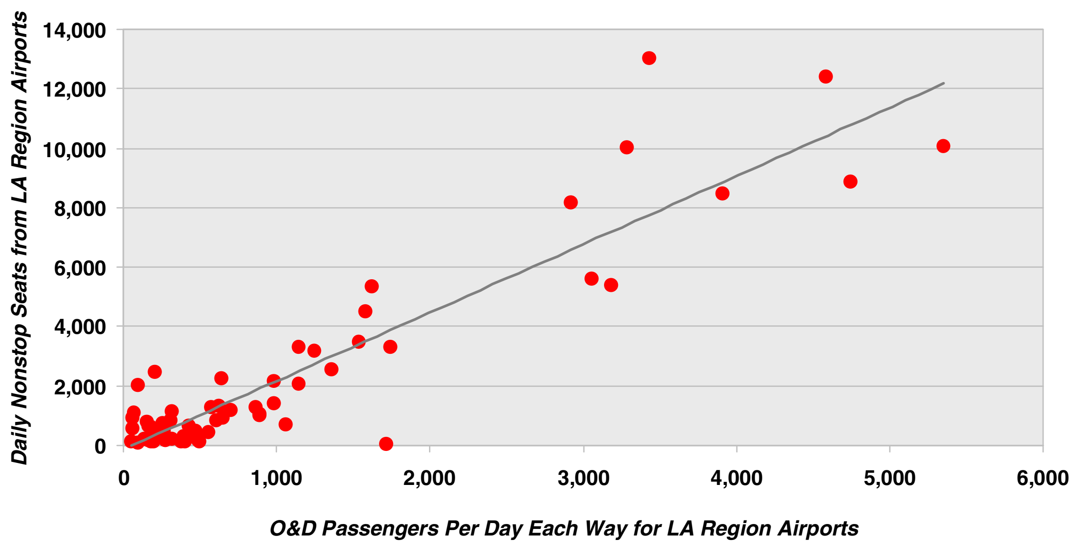
Figure 7.5: Relationship Between O&D Passenger Volume and the Number of LA Region Airports with Nonstop Service



Source: Service based on February 2001 published flight schedules. O&D passengers for the year ending 6/30/01.

The ability to forecast the level of nonstop seat capacity that will be provided from the region's airports to individual destinations will be important in projecting the number of nonstop flights that will be distributed among the region's airports. A regression analysis associating nonstop seat capacity to total regional O&D passenger volume was performed for the 64 destinations that received nonstop service from the LA region in February, 2001. The analysis shows a strong correlation between O&D passenger volume and nonstop seat capacity, producing an R-squared value of 0.84. This relationship is displayed in Figure 7.6.

Figure 7.6: Relationship Between Nonstop Seat Capacity and O&D Passengers in the LA Region



Source: Service based on February 2001 published flight schedules. O&D passengers for the year ending 6/30/01.

In developing the forecasting relationships that will be applied to project nonstop seat capacity, flight frequencies, and the distribution of services across the airports in the region, we expect to refine the analyses described above to account for factors such as the following:

- The ratio of connecting traffic to local O&D passengers for hub and focus city destinations, and for LAX which functions as an international gateway and regional hub;
- Differences in passenger demand thresholds that are observed in long-haul versus short- and medium-haul markets; and
- Differences in average aircraft size that characterize different market classes.

Sequencing and Location of New Nonstop Services

The service forecasting module will also need to project the specific Southern California airports where future domestic and international services will be offered. In forecasting the distribution of services by airport, information will be gained from observing the current degree of service development at these airports. As evident in Figure 7.4, there is a general sequence with which the region's airports have developed service to specific air destinations.

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LAX is the largest commercial airport in the region and had nonstop service in nearly every domestic nonstop market that was served to any of the Southern California airports. Overall, LAX received nonstop services to all 20 of the region's Top 20 domestic O&D markets, 47 of the Top 50, and 63 of the Southern California region's top 100 domestic markets.

In addition, LAX is one of the nation's leading international gateways. As shown in Figure 7.7, LAX received nearly 1,000 weekly international departures in February 2001, including extensive long-haul services to Asia, Australia and New Zealand, Europe and South America. With the exception of San Diego, which receives British Airways nonstop service to London, LAX is the only Southern California airport that receives long-haul international services .

Figure 7.7: Weekly International Flights from Southern California Airports – February 2001

Rank	Destination	Code	LAX Mileage	Weekly Departures by Airport: Total	LAX	PSP	ONT	SAN
Mexico/Central America								
1	Mexico City	MEX	1,553	87	87			
2	Guadalajara	GDL	1,307	81	79		2	
3	San Jose Del Cabo	SJD	913	55	41			14
4	Puerto Vallarta	PVR	1,218	25	25			
5	San Salvador	SAL	2,304	21	21			
6	Leon-Guanajuato	BJX	1,321	14	14			
7	Guatemala City	GUA	2,193	14	14			
8	Hermosillo	HMO	546	14	14			
9	Mazatlan	MZT	1,046	13	13			
10	Manzanillo	ZLO	1,346	11	11			
11	Cancun	CUN	2,115	8	8			
12	Culiacan	CUL	912	7	7			
13	Loreto	LTO	691	7	7			
14	Morelia	MLM	1,439	7	7			
15	Panama City	PTY	3,008	7	7			
16	Ixtapa/Zihuatanejo	ZIH	1,539	7	7			
17	La Paz	LAP	835	5	5			
18	Durango	DGO	1,075	4	4			
19	Aguascalientes	AGU	1,287	3	3			
20	Torreon	TRC	1,067	3	3			
21	Tijuana	TIJ	126	1	1			
	Subtotal			394	378	0	2	14
Canada								
1	Vancouver	YVR	1,079	82	80	2		
2	Toronto	YTO	2,180	52	45			7
3	Calgary	YYC	1,205	15	15			
4	Edmonton	YEA	1,358	7	7			
5	Montreal	YMQ	2,466	7	7			
6	Winnipeg	YWG	1,538	1		1		
	Subtotal			164	154	3	0	7
Long Haul International								
1	Tokyo	TYO	5,454	65	65			
2	London	LON	5,447	56	49			7 *
3	Taipei	TPE	6,769	37	37			
4	Sydney	SYD	7,491	34	34			
5	Seoul	SEL	5,959	31	31			
6	Auckland	AKL	6,514	24	24			
7	Paris	PAR	5,652	22	22			
8	Hong Kong	HKG	7,230	21	21			
9	Osaka	OSA	5,703	17	17			
10	Sao Paulo	SAO	6,134	17	17			
11	Frankfurt	FRA	5,788	16	16			
12	Melbourne	MEL	7,924	14	14			
13	Beijing	BJS	6,232	11	11			
14	Papeete	PPT	4,106	11	11			
15	Amsterdam	AMS	5,562	7	7			
16	Milan	MIL	6,034	7	7			
17	Zurich	ZRH	5,920	7	7			
18	Nagoya	NGO	5,616	7	7			
19	Lima	LIM	4,173	7	7			
20	Nadi	NAN	5,522	6	6			
21	Montego Bay	MBJ	2,703	5	5			
22	Guangzhou	CAN	7,227	4	4			
23	Dublin	DUB	5,165	3	3			
24	Moscow	MOW	6,081	3	3			
25	Buenos Aires	BUE	6,118	3	3			
26	Noumea	NOU	6,275	2	2			
27	Apia	APW	4,823	1	1			
28	Rarotonga	RAR	4,680	1	1			
	Subtotal			439	432	0	0	7
	Total			997	964	3	2	28

* In February 2001 service to London from San Diego was provided on a one-stop basis over PHX. Currently BA serves San Diego-London nonstop with 5 weekly departures.
Source: OAG Schedule Tapes.

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Aviation System Planning Consultant

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San Diego is the second largest airport in the Southern California region in terms of passenger traffic and available airline services. San Diego received nonstop services to 34 domestic destinations, including 18 of the region's Top 20 O&D markets, and 31 of the Top 50.

For the region's sencondary airports, there is a natural pattern of service development evidenced by the evolution and types of services offered. Typically, the secondary airports receive service first to the highest density short- and medium-haul destinations. Service is also typically provided to major connecting hubs, particularly those in the short- and medium-haul categories, since these hubs offer the widest range of connecting opportunities meeting a circuity threshold.

Within the SCAG region, Orange County (John Wayne) and Ontario received similar coverage in terms of nonstop destinations served, although flight frequency levels at Orange County were approximately 20 percent higher than at Ontario. In February, 2001, these airports each received nonstop service to 16 of the region's Top 20 domestic destinations, and to 18 (ONT) and 19 (SNA) of the region's Top 50 markets.

Burbank received a total of 80 daily departures to 10 nonstop destinations—all ranked within the region's Top 20 domestic markets. Palm Springs received 60 daily departures serving 12 of the region's Top 20 markets in February, 2001, which is the peak season for this resort market.

As of February, 2001, Long Beach was provided with only 11 daily domestic departures to 4 nonstop destinations, including Las Vegas, Phoenix and Dallas/Ft.Worth. However, service levels and passenger traffic at Long Beach have grown considerably since 2001, with the introduction of new services by jetBlue and the competitive expansion of American Airlines. The recent services introduced at Long Beach are somewhat different than those offered at the other regional airports. The markets being added reflect the route network of jetBlue and several are long-haul, although all markets are high density. Given Long Beach's central location, close to an extremely high number of passenger ground origins with excellent highway access, a large number of high volume markets could be sustainable, particularly with a fare advantage over the surrounding airports of LAX and Orange County. By serving Long Beach, jetBlue also gains competitive differentiation from services already being provided at surrounding airports.

The apparent hierarchy in terms of airport roles, services and traffic development will help to guide the service forecasting module in terms of the sequence in which the

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Aviation System Planning Consultant

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regional airports may receive services to new nonstop destinations as passenger demand grows in the future.

In addition to the historical service patterns, however, we also plan to consider the concentration of passenger demand to and from specific air destinations that exists in the region surrounding the individual airports. Where high density demand is present that cannot be accommodated by historically provided services, new nonstop services are most likely to be added. This factor will be critical to the evaluation of potential new airport locations and will help to guide service development scenarios for both new and established airport locations.

In assigning new nonstop markets to individual airports, it may be appropriate to establish minimum flight frequency thresholds in certain market classes. For example, to introduce new service from an airport in high density, short-haul markets such as the Bay Area destinations, it might be necessary to add a minimum number of daily roundtrip flights. Any minimum threshold would likely be related to the level of flight frequency provided by individual carriers at surrounding, competing airports.

A factor that might be significant in identifying target markets at an airport is the share that it currently attracts of total regional passengers in markets where the airport has well-developed services. For example, if Ontario currently attracts 15 to 25 percent of the LA region's total O&D passengers in well established markets such as Oakland, Phoenix, and Portland, would a similar share of regional O&D to potential new destinations be sufficient to support a minimum threshold level of flight frequency in those markets?

Air Fare

The potential fare levels that could be realized on new services play a vital role in determining the viability of the proposed new services. Similarly, the differential fare levels available at the various regional airports play a major role in the airport choice process. Exhibit 7.8 presents the average fare by domestic destination for the airports in Southern California. An examination if this fare data demonstrates that there are clear differences in the fare levels offered at each of the Southern California airports. For example, the average fares paid at John Wayne for the top 20 O&D destinations were equal to or higher than the fares paid at both LAX and Ontario for travel to the same destinations. These fare differentials can likely be explained by factors such as the market share of low-fare carriers to the air destination in question and the proximity of other airports with nonstop service to the same destination. The

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availability of different fare levels and the fare differentials among airports and airlines will be examined in much greater detail as the development of the air service forecasting model proceeds.

Figure 7.8: Average Fares by Domestic Destination for Southern California Airports – YE 2Q 01

O&D Rank	Market	Code	LAX N/S Miles	Total O&D Psgrs	Percent of Total	Average Fare by Airport LAX	SNA	ONT	BUR	PSP	LGB	SAN
1	Oakland	OAK	336	4,714,690	7.0%	$66	$76	$66	$70	$104	$0	$73
2	Las Vegas	LAS	235	4,098,900	6.1%	$59	$93	$59	$59	$95	$54	$62
3	New York	NYC	2,454	4,014,360	5.9%	$284	$314	$185	$268	$299	$250	$284
4	San Jose	SJC	306	3,718,790	5.5%	$67	$79	$68	$70	$97	$0	$74
5	Phoenix	PHX	368	3,273,180	4.8%	$57	$144	$59	$58	$112	$74	$59
6	San Francisco	SFO	336	3,236,730	4.8%	$94	$104	$84	$95	$102	$0	$77
7	Sacramento	SAC	359	3,055,540	4.5%	$67	$122	$68	$68	$137	$196	$69
8	Seattle/Tacoma	SEA	954	2,774,900	4.1%	$124	$136	$116	$119	$115	$149	$127
9	Chicago	CHI	1,746	2,595,200	3.8%	$190	$215	$177	$178	$200	$172	$193
10	Portland	PDX	833	1,588,030	2.3%	$113	$123	$111	$114	$105	$143	$116
11	Denver	DEN	846	1,564,090	2.3%	$182	$219	$197	$205	$197	$145	$165
12	Dallas/Fort Worth	DFW	1,231	1,536,200	2.3%	$223	$264	$215	$261	$224	$178	$231
13	Salt Lake City	SLC	589	1,379,460	2.0%	$81	$103	$86	$85	$126	$84	$99
14	Washington	WAS	2,297	1,270,970	1.9%	$284	$284	$231	$273	$316	$258	$297
15	Honolulu	HNL	2,551	1,241,960	1.8%	$186	$235	$285	$245	$279	$0	$242
16	Atlanta	ATL	1,940	1,133,660	1.7%	$241	$281	$238	$279	$272	$245	$242
17	Baltimore	BWI	2,322	1,099,920	1.6%	$181	$227	$157	$164	$222	$190	$153
18	Houston	HOU	1,385	1,034,180	1.5%	$187	$267	$174	$167	$217	$211	$184
19	Boston	BOS	2,603	1,033,520	1.5%	$260	$304	$245	$285	$279	$267	$258
20	Minneapolis	MSP	1,531	946,960	1.4%	$179	$236	$199	$249	$181	$168	$179
21	Detroit	DTT	1,982	899,850	1.3%	$198	$252	$173	$160	$229	$168	$197
22	Philadelphia	PHL	2,393	845,460	1.2%	$241	$294	$251	$286	$286	$236	$246
23	Orlando	ORL	2,207	789,670	1.2%	$191	$214	$155	$192	$247	$226	$161
24	Reno	RNO	390	786,700	1.2%	$76	$82	$80	$79	$130	$82	$81
25	Tucson	TUS	449	712,770	1.1%	$56	$179	$80	$80	$172	$64	$55
26	Kansas City	MKC	1,363	619,300	0.9%	$124	$157	$143	$148	$168	$127	$134
27	St. Louis	STL	1,587	616,270	0.9%	$201	$236	$162	$156	$186	$187	$173
28	Albuquerque	ABQ	675	579,630	0.9%	$108	$174	$110	$108	$200	$106	$111
29	New Orleans	MSY	1,666	515,200	0.8%	$149	$158	$140	$151	$200	$163	$141
30	Kahului	OGG	2,482	479,630	0.7%	$208	$251	$259	$311	$282	$0	$230
31	Miami	MIA	2,336	475,220	0.7%	$249	$242	$214	$229	$263	$221	$228
32	Indianapolis	IND	1,809	458,150	0.7%	$143	$179	$146	$157	$179	$169	$153
33	Fort Lauderdale	FLL	2,337	445,280	0.7%	$171	$211	$150	$172	$226	$194	$161
34	Austin	AUS	1,234	436,860	0.6%	$154	$172	$138	$137	$170	$153	$140
35	Tampa	TPA	2,152	436,810	0.6%	$181	$228	$170	$188	$213	$194	$171
36	Cleveland	CLE	2,046	434,740	0.6%	$197	$223	$166	$182	$202	$196	$163
37	Nashville	BNA	1,791	390,570	0.6%	$169	$173	$140	$158	$186	$213	$143
38	Columbus	CMH	1,989	387,890	0.6%	$154	$182	$143	$183	$191	$184	$140
39	Hartford	HFD	2,521	371,040	0.5%	$203	$254	$165	$177	$239	$239	$179
40	San Antonio	SAT	1,207	363,840	0.5%	$138	$164	$133	$149	$165	$152	$143
41	Raleigh/Durham	RDU	2,232	355,280	0.5%	$160	$241	$151	$171	$184	$218	$158
42	Providence	PVD	2,584	328,930	0.5%	$152	$193	$160	$133	$191	$148	$163
43	Pittsburgh	PIT	2,129	302,960	0.4%	$224	$251	$229	$263	$251	$312	$229
44	El Paso	ELP	712	294,540	0.4%	$113	$197	$118	$109	$199	$111	$117
45	Milwaukee	MKE	1,750	291,780	0.4%	$165	$210	$181	$182	$180	$154	$174
46	Spokane	GEG	944	271,710	0.4%	$115	$120	$113	$117	$125	$136	$116
47	Omaha	OMA	1,326	269,620	0.4%	$139	$150	$126	$135	$157	$138	$127
48	Boise	BOI	674	251,360	0.4%	$105	$123	$103	$106	$134	$105	$115
49	Cincinnati	CVG	1,894	250,000	0.4%	$249	$280	$226	$340	$228	$308	$212
50	Charlotte	CLT	2,126	236,770	0.3%	$255	$287	$269	$317	$279	$276	$243
51	Los Angeles	LAX	0	218,490	0.3%	$0	$18	$20	$48	$79	$0	$82
52	Oklahoma City	OKC	1,183	211,750	0.3%	$146	$151	$139	$147	$180	$172	$136
53	Kona	KOA	2,502	195,080	0.3%	$244	$279	$277	$162	$301	$0	$275
54	Colorado Springs	COS	830	191,420	0.3%	$176	$192	$183	$189	$154	$167	$165
55	Tulsa	TUL	1,279	187,690	0.3%	$158	$155	$139	$144	$157	$214	$137
56	Manchester	MHT	2,579	182,190	0.3%	$159	$204	$161	$134	$203	$339	$153
57	Jacksonville	JAX	2,146	181,460	0.3%	$172	$187	$170	$140	$257	$337	$169
58	Louisville	SDF	1,837	178,310	0.3%	$160	$155	$167	$145	$212	$246	$147
59	Norfolk	ORF	2,364	171,570	0.3%	$215	$236	$229	$306	$271	$332	$217
60	Memphis	MEM	1,614	165,740	0.2%	$234	$285	$224	$245	$234	$280	$215

Source: Source: US DOT, O&D Database, Database Products Inc.

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Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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Figure 7-8 : *Continued*

O&D Rank	Market	Code	LAX N/S Miles	Total O&D Psgrs	Percent of Total	Average Fare by Airport						
						LAX	SNA	ONT	BUR	PSP	LGB	SAN
61	Albany	ALB	2,460	164,890	0.2%	$147	$201	$154	$141	$190	$36	$133
62	Anchorage	ANC	2,341	161,930	0.2%	$192	$206	$211	$224	$177	$82	$189
63	Buffalo	BUF	2,210	161,850	0.2%	$160	$226	$174	$131	$192	$234	$149
64	Kauai Island	LIH	2,611	151,870	0.2%	$240	$225	$285	$376	$326	$0	$244
65	San Diego	SAN	109	151,640	0.2%	$82	$60	$76	$0	$57	$0	$0
66	Birmingham	BHM	1,810	147,150	0.2%	$154	$205	$158	$143	$226	$197	$151
67	Fresno	FAT	209	143,130	0.2%	$102	$106	$103	$140	$119	$40	$130
68	Monterey	MRY	266	139,160	0.2%	$107	$115	$117	$161	$124	$0	$115
69	West Palm Beach	PBI	2,323	135,710	0.2%	$195	$223	$191	$310	$245	$214	$177
70	San Juan	SJU	3,380	134,400	0.2%	$270	$323	$298	$311	$361	$395	$306
71	Little Rock	LIT	1,488	126,610	0.2%	$153	$185	$146	$138	$178	$193	$153
72	Eugene	EUG	747	122,390	0.2%	$120	$134	$139	$131	$136	$123	$135
73	Richmond	RIC	2,298	110,240	0.2%	$239	$247	$248	$261	$281	$225	$227
74	Grand Rapids	GRR	1,869	104,590	0.2%	$182	$213	$222	$246	$196	$166	$193
75	Greensboro	GSO	2,165	94,630	0.1%	$208	$264	$223	$418	$307	$286	$200
76	Des Moines	DSM	1,443	90,680	0.1%	$170	$207	$204	$212	$210	$174	$179
77	Dayton	DAY	1,919	88,110	0.1%	$213	$255	$217	$378	$186	$315	$209
78	Rochester	ROC	2,265	85,070	0.1%	$234	$248	$217	$123	$215	$136	$214
79	Wichita	ICT	1,199	80,670	0.1%	$223	$188	$204	$230	$206	$291	$168
80	Medford	MFR	629	79,770	0.1%	$136	$157	$148	$142	$145	$0	$141
81	Madison	MSN	1,680	77,730	0.1%	$166	$182	$191	$228	$182	$0	$186
82	Islip	ISP	2,502	75,710	0.1%	$130	$292	$126	$134	$171	$206	$143
83	Syracuse	SYR	2,343	73,950	0.1%	$214	$212	$265	$314	$233	$167	$224
84	Fort Myers	FMY	2,225	65,180	0.1%	$211	$221	$210	$155	$253	$94	$208
85	Huntsville	HSV	1,796	64,300	0.1%	$205	$275	$233	$276	$200	$287	$212
86	Jackson	JAN	1,636	63,620	0.1%	$159	$180	$149	$180	$179	$250	$153
87	Charleston	CHS	2,199	60,590	0.1%	$237	$243	$244	$226	$368	$0	$295
88	Cedar Rapids	CID	1,546	60,010	0.1%	$212	$238	$230	$173	$177	$210	$196
89	Greenville/Spartanburg	GSP	2,050	56,740	0.1%	$262	$321	$266	$328	$249	$302	$256
90	Santa Barbara	SBA	88	55,430	0.1%	$67	$77	$80	$0	$111	$0	$113
91	Knoxville	TYS	1,943	55,330	0.1%	$233	$244	$221	$275	$292	$313	$218
92	Eureka	EKA	567	54,550	0.1%	$132	$109	$104	$104	$131	$0	$100
93	San Luis Obispo	CSL	154	53,600	0.1%	$92	$96	$95	$0	$130	$0	$116
94	Harrisburg	HAR	2,313	53,460	0.1%	$232	$270	$285	$278	$188	$188	$216
95	Palm Springs	PSP	109	50,880	0.1%	$79	$71	$0	$0	$0	$0	$57
96	Springfield	SGF	1,418	49,050	0.1%	$183	$164	$160	$183	$173	$217	$163
97	Sioux Falls	FSD	1,337	49,030	0.1%	$158	$159	$150	$171	$180	$0	$153
98	Savannah	SAV	2,145	48,290	0.1%	$243	$260	$254	$612	$280	$495	$214
99	Fayetteville	FYV	1,375	46,190	0.1%	$172	$193	$180	$311	$235	$241	$166
100	Santa Rosa	STS	399	45,770	0.1%	$117	$118	$122	$107	$115	$0	$112
	Subtotal Top 100			64,726,670	95.6%							
	All Other			2,995,980	4.4%							
	Total			67,722,650	100.0%							

Source: Source: US DOT, O&D Database, Database Products Inc.

MODEL APPLICATION AND IMPLEMENTATION ISSUES

Factors such as those described above will be evaluated during development of the service forecasting module. The methods and variables that produce the most credible and reasonable service development scenarios will be incorporated into the design of this model component. As previously described, future airport service pattern scenarios will be evaluated for feasibility through an internal feedback loop, with service levels adjusted until the level of passenger demand attracted to individual airports is consistent with the estimated levels of service.

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Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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Growth constraints at many of the region's airports will limit the service expansion opportunities at these facilities. However, the model will be designed to allow constraints at one or more of the region's airports to be lifted, in order to evaluate the implications of unconstrained or less-constrained scenarios.

In addition to airport constraints or caps related to the overall number of flights or passengers, facility constraints such as available runway length could limit new service options at certain airports. Minimum runway length requirements will be established for various classes of service and markets (e.g., long-haul international routes).

It is our intention that SCAG and other regional agencies will employ the Regional Airport Demand Model for many years to come. To this end, it is essential that the model be capable of accepting externally specified service patterns, just as it will accept exogenous forecasts of passenger demand. The starting point for an air service (or passenger traffic) forecasting procedure is typically the recent actual levels and patterns of services and passenger traffic that have been observed in the region. If planners are applying the model several years in the future, they should benefit from the changes in traffic and services that will inevitably have occurred since the initial model development.

To accommodate this requirement, we intend to design the model to receive recent flight schedules as inputs, in addition to current information regarding the regional distribution of passenger demand by air market. The service forecasting model will take the input services as a starting point, and develop future service scenarios from this base period.

In addition, by allowing users to input specific service scenarios, the model can be applied to test the viability of specific new routes at individual airports. This capability could be valuable to airport stakeholders when attempting to attract new airline services.

As with all elements of the Regional Airport Demand Model, the Service Forecasting Component will be designed in a modular fashion to permit future enhancement and refinement.

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Aviation System Planning Consultant

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8 NEXT STEPS IN MODEL DEVELOPMENT

The current phase of the model development effort has included the analysis of available literature on the different components of airport modeling, the assembly and review of available air passenger survey data and other key model input data, and the development of this model design. In the next phase of the effort, we expect to proceed on three model development tasks defined in the overall project scope:

- Further Assembly of Available Model Input Data and Forecasts;
- Further Refinement of the Model Design; and
- Development of the Air Passenger Demand Model Component Modules.

The study team has already begun a concerted effort to create the databases that are needed to develop and validate the regional airport demand model system. Once the modeling approach is agreed upon, we will be able to focus this effort, and assemble as much of the data as necessary to implement the model plan.

Many types of data and forecasts are being collected and assembled, including:

- Air traveler survey data for model estimation;
- Data on households and employment at the level-of-detail of the SCAG zones;
- Available airport passenger traffic volume data on landside access trips;
- Airport activity estimates and forecasts;
- Airline service information for all scheduled services at the Southern California airports;
- Airline passenger origin-destination data; and
- Level-of-service data and forecasts for airport landside access trips.

These data and forecasts will first be used in the development of the intercity passenger trip generation models and the intercity market demand models. We will organize the available base year and forecast year zone estimates, air service estimates, and airport access service level estimates. We will then build models to relate the travel patterns detailed in the airport passenger surveys to the other base year data, as described in Section 5 of this Model Design. We will test alternative specifications and model formulations before selecting and presenting a preferred set of models.

In parallel to the model development effort for the first model component, the project team will further refine the high level design for the overall model system. This design will address the issues related to model complexity/run time tradeoffs, the need for the ability to incorporate exogenous forecasts, and the required reporting formats and model outputs.

Dr. Geoffrey D. Gosling
Aviation System Planning Consultant

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